

The Victorian Government Prize Essay

ESSAY

ON

MANUFACTURES, TRADE, INDUSTRY, AND AGRICULTURE

IN THE COLONY OF VICTORIA

RESOURCES OF THE COLONY,

WITH SPECIAL REFERENCE TO THE MANUFACTURING AND AGRICULTURAL RESOURCES OF THE COLONY, AND THE PROSPECTS OF THE FUTURE.

BY

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OF THE

THE VICTORIAN GOVERNMENT PRIZE ESSAY

1861



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ESSAY

ON THE

MANUFACTURES MORE IMMEDIATELY REQUIRED

FOR THE ECONOMICAL DEVELOPMENT OF THE

RESOURCES OF THE COLONY,

WITH SPECIAL REFERENCE TO THOSE MANUFACTURES THE RAW
MATERIALS OF WHICH ARE THE PRODUCE OF VICTORIA.

MOTTO

"CIVIL ENGINEER."

BY CHARLES MAYES, C.E.



By Authority:

JOHN FERRES, GOVERNMENT PRINTER, MELBOURNE.

1861.



INTRODUCTION.



IN accordance with an advertisement emanating from the Royal Society of Victoria, dated March 28th, 1860, inviting Competitive Essays on four different subjects, I have turned my attention to the compilation of the Essay on Manufactures, the object of which is more particularly described in the words of the advertisement, which I have given on the title page.

In commencing this Essay I directed my attention first to the *Raw Materials* of the colony; the chief of these will be found in the following list, which I have divided into three parts, distinguishing the Mineral, Vegetable, and Animal productions, with a succinct account of the manufactures to which they are applied, omitting those productions that are not likely to be produced to a sufficient extent for manufacturing purposes :—

MINERAL SUBSTANCES.

Name.				Application.
Basalt	...	...	...	When liquified by incineration it has been cast into chimney-pieces, &c.
Clay (pottery)	...	...	...	Bricks, tiles, earthenware, stoneware.
„ (fire)	...	...	...	Firebricks, pots for melting glass, <i>Saggars</i> or boxes for baking pottery, porcelain &c., for lining and luting furnaces, for crucibles, retorts, &c.
„ (kaolin or china)	...	...	...	Porcelain, delftware, crockery, &c.
Cement stones	...	...	...	Cement or hydraulic lime.
Coal	...	...	...	Coke, gas, tar; and from coal-tar is produced coal-tar oil, naphtha, pitch; ammoniacal liquor, from which may be produced sulphate, carbonate, muriate, &c., of ammonia. Soot from coal also yields carbonate of ammonia.

Name.	Application.
Feldspar... ..	Glass, porcelain, glaze for pottery.
Gems—viz., diamonds, topaz, beryl, opal, aquamarine, garnet, tourmaline, sapphires, ruby, quartz crystals, &c.	Diamond for cutting glass, and for diamond powder. Gems generally for jewellery.
Gold	Bullion, jewellery, gold leaf, &c.
Iron (native), ores, hæmatite, carbonate, titaniferous sand, &c.	Cast and malleable iron, steel, &c., for conversion into hardware or iron-mongery, and for medicinal purposes.
Limestone	Lime for manure, mortar, flux, &c. Limestone mixed with alumina or clay forms (when calcined) cement and hydraulic lime.
Manganese (oxide)	Glass of certain kinds, enamel.
Quartz (milk)	Glass, substitute for flints in pottery; with an equal portion of alumina or disintegrated feldspar it forms an infusible fire-clay like <i>kaolin</i> , as a substitute for sand in the preparation of clays for earthenware, and for forming moulds in foundries.
Salt from salt lakes, and from sea water	Crude carbonate of soda or soda ash for glass and soap, pure carbonate of soda, muriatic acid, &c.
Sludge from puddling-machines	Bricks, tiles, pipes, and other earthenware.
Tin ore (stream tin, also known as "black sand")	Block tin, tin plates or sheet tin, bronze, pewter, tinfoil, mordants, enamel, glazes for crockery, &c.

Other minerals have been found of great value in manufactures, but not hitherto in sufficient quantities to render them important in a commercial point of view; the chief of these are sulphuret of antimony,* sulphuret of iron, bismuth glance, Tripoli, sulphur, silver ore, galena or argentiferous lead ore, copper ore, &c.

If sulphuret of antimony, or sulphuret of iron (iron pyrites), could be found in sufficient quantity they might be used in the manufacture of sulphuric acid, but these materials for such a purpose have been elsewhere superseded by sulphur and nitre.

* From a pencil note by J. W. Osborue, Esq., in the margin of the manuscript of this Essay, I find that the owner of a quartz reef near Heidelberg told him that he had shipped several tons of antimony ore from that locality, to be calcined, at a considerable profit.—C. MATES, June 24, 1861.

VEGETABLE PRODUCTIONS.

Name.	...	...	...	Application.
Arrowroot plant	...	...	...	Arrowroot of commerce (<i>a sample of arrowroot grown in Victoria was exhibited at the Victorian Exhibition, 1854</i>).
Almond (sweet and bitter)	...	...	...	Unctuous oil for perfumery, soap, &c.
Bark (wattle, black wood, acacia, eucalypti, &c.)	...	...	...	Tan (chiefly from wattle), used in tanning leather, and for this purpose exported into England, &c.
Barley (various), bere, or bigg	...	...	...	Meal, pearl barley, malt, pale and dark, malt vinegar; with bere and juniper berries Hollands gin is produced by distillation; from these <i>cereals</i> are also produced whiskey and other spirits.
Beetroot...	...	...	...	Sugar as in France, beer, &c.
Beans (French)...	...	...	...	Pickles, stalks calcined for potash.
Carraway seed (A)	...	...	...	Essential oil for perfumery, &c.
Cucumber	...	...	...	Unctuous oil of commerce, and pickles.
Castor-oil plant (A)	...	...	...	Castor-oil as an unguent and medicine.
Colza-oil plant (A)	...	...	...	Colza oil for lamps, pigments, &c.
Cabbage and cauliflower	...	...	...	Pickles.
Flax (inner bark of)	...	...	...	Cordage, string, twine, potash from stems.
Fruits (apricots, pears)	...	...	...	Dried fruit, jams, perry from pears.
„ (apples, raspberries)	...	...	...	Cyder, raspberry vinegar, preserves.
„ (currant, gooseberry)	...	...	...	Wine and jams, preserves.
„ (elderberry)	...	...	...	Wine, and with grapes port wine.
„ (plum fruit and kernel)	...	...	...	Jam, preserves, and plum-kernel oil.
„ (cherry and kernel)	...	...	...	Ditto ditto, and cherry-stone oil.
„ (peaches)	...	...	...	Ditto ditto, and dried peaches.
„ (bergamot, A)	...	...	...	Essential oil for perfumery, &c.
Gum acacia, &c.; wattle gum, &c.	...	...	...	Varnishes, medicine, in textile manufactures for stiffening silk, crape, &c.
Grapes	...	...	...	Wine, brandy, jam, &c.
Grape seed	...	...	...	Grape-seed oil; the lees of wine, when calcined, yield more potash than any other substance, about 16 per cent.
Hemp	...	...	...	Ropes, canvas, or sail-cloth, &c.
„ seed	...	...	...	Unctuous oil.
Hop plant	...	...	...	Hops for brewing, &c.
Jessamine (blossoms)	...	...	...	Essential oil for perfumery, &c.
Lavender	...	...	...	Essential oil for perfumery, &c.
Linseed-oil plant	...	...	...	Oil for pigments, and linseed-oil cake.
Maize	...	...	...	Meal, beer, sugar, paper, and potash from the calcined stems.
Mulberry tree	...	...	...	Food for silk worms, fruit for jams.
Narcissus (blossoms)	...	...	...	Essential oil for perfumery, &c.
Olive tree (A)	...	...	...	Olive oil for salad oil, soap, &c.
Oats (various)	...	...	...	Oatmeal and groats, oats for whiskey.

Name.	Application.
Onions	Pickles.
Oranges (blossoms, &c.) (A) ...	Fruit for marmalade, blossoms for <i>Neroli</i> .
Paper plant (A)	Cotton and flax, grown in Wisconsin, U.S.
Poppy	Unctuous oil, opium of commerce.
Potatoes (various), and sweet potato.	Beer of Strasburgh, British brandy, starch, sugar; potato pulp is a good substitute for arrowroot.
Peach blossoms	Essential oil for perfumery, &c.
Rape-seed oil plant	Rape-seed oil.
Roses	Otto, or essential oil of, for perfumery.
Sassafras tree	Bark used in medicine (indigenous).
Straw of wheat, &c.	Straw plait for hats and caps.
Sunflower	Seed for oil, stems calcined for potash.
Sorghum saccharatum	Sugar, and the stems for paper and potash.
Trees (native)	Baskets (at Victorian Exhibition, 1854).
„ bark of ditto	Substitute for flax and hemp in the manufacture of cordage, paper, &c.
„ leaves of gum, &c.	Olefant gas and spirito-crude oil,* made at Kyneton Gas Works.
„ branches and twigs	Potash, pyroligneous acid or wood vinegar, acetic acid, &c.
„ timber (waste)	Charcoal, wood vinegar, wood tar, pitch, creosote, potash, and gas.
„ timber (seasoned)	Coachbuilding, gigs, buggies, land and railway carriages, cars, carts, drays, wagons; also for furniture, turnery, woodenware, lasts for shoes, &c.
Thyme and rosemary	Essential oils for soap and perfumery.
Tobacco (Havannah)	Tobacco for smoking, and for cigars, twist, sheepwash, snuff, &c.
Thistles (full grown)	Potash to the amount of 4 per cent.
Violet (blossoms)	Essential oil for perfumes.
Vanilla (A)	Chocolate, confections, and perfumes.
Wheat	Flour, bread, biscuits, confections, starch, macaroni, vermicelli, whiskey, and other spirits.
Walnut (fruit)	Pickles and walnut oil.

Those plants, &c., which, as far as I can ascertain, have not been acclimatized I have marked with the letter (A), thinking it better that all doubtful productions should be kept distinct from those that have been fairly tried and found successful.

* Spirito-crude oil is the name given by the patentee who invented and manufactured this gas, &c., at the Kyneton Gas Works. See Specification of Patent in the Registrar-General's office, Melbourne.—C. MAYES, June 24, 1861.

ANIMAL PRODUCTS.

Name.				Application.
Blood and offal ...	...	...	...	Carbonate of ammonia.
Bones ...	...	...	...	Combs, brushes, spoons, knife and fork handles, &c., waste bone for manure, lampblack, animal charcoal or bone ash, carbonate of ammonia, &c.
Bristles (hogs) ...	...	...	...	Toilet brushes, painters' brushes, &c.
Calves and neats' feet ...	...	...	...	Jelly, neatsfoot oil, glue, &c.
Entrails or guts ...	...	...	...	Strings of musical instruments, &c.
Furs of opossum, kangaroos, rabbits, &c.				Nap for felt and stuff hats, and for the best kinds of felt.
Fish (various), whale, and fish bones.				Cured and dried, whale oil and fish oil, spermaceti, isinglass from fish bones.
Horns ...	...	...	...	Cups, flasks, combs, knife and fork handles, rings, carbonate of ammonia, &c.
Hoofs ...	...	...	...	Glue, ammonia, and substitutes for horn.
Hair from cows, dogs, horses, cats, &c.				Hair felt for roofing, coating boilers, inodorous felt for partitions, felt hats, &c.
Lard (hogs) ...	...	...	...	Porcine oil, pomades, confections.
Meat (butchers') ...	...	...	...	Bacon, hams, beef, cured and spiced; beef and pork, pickled or salted.
Ordure of horses ...	...	...	...	Ammonia and nitre from nitre beds.
Sheeps' feet ...	...	...	...	Sheep-trotter oil, glue, and ammonia.
Skins (horses hides) ...	...	...	...	Cordovan for saddlery, shagreen for cases, glue, and ammonia.
„ (hides of oxen) ...	...	...	...	Sole leather; waste hide for glue.
„ (calves) ...	...	...	...	Upper leather and kip; ditto.
„ (pigs) ...	...	...	...	Leather for saddles; ditto.
„ (kids and dogs) ...	...	...	...	„ for shoes, gloves, &c.
„ (goats) ...	...	...	...	Morocco or Turkish leather.
„ (sheep) ...	...	...	...	Parchment, size, housings, &c.
„ (kangaroo) ...	...	...	...	Upper leather for dress boots, shoes, &c.
„ waste (all kinds) ...	...	...	...	Glue or gelatine, ammonia, &c.
Tallow (beef and mutton) ...	...	...	...	Soap, common and toilet, also common and stearine candles; anti-friction grease for railway and road carriages, machinery, &c.
Urine ...	...	...	...	Alum, tanning ley for Morocco and other leather; carbonate of ammonia, and nitre from nitre beds.
Wool (sheep, angola, alpaca) ...				Woollen manufactures, cloth, &c.; woollen rags for carbonate of ammonia.

Such are the principal productions of Victoria, an infant colony, whose rapid growth and development is a source of wonder to the civilized world.

Mineral
resources.

Our mineral resources, although unprecedented, are not yet fully developed, and are far from being explored by the practical geologist or mineralogist. Much important information may be obtained from the reports and maps that have been published by the Government Geologist, although they extend over a very small area as compared with the great extent of country, of which we know comparatively little as to its resources. It is not at all unlikely that we may yet discover lead, copper, antimony*, bismuth, zinc, silver, sulphur (from our extinct volcanoes), and other valuable minerals, in sufficient quantities for commercial purposes, and that we may discover hæmatite, the most valuable of the iron ores, in far greater abundance than we can at present have any idea of.

Acclimatization
of plants in Vic-
toria, &c.

All that we possess in the vegetable kingdom, with a few exceptions, are in the form of "acclimatized plants," imported from England, where they have been previously introduced and acclimatized since the reign of Henry the Eighth. The *Flora* of England includes upwards of 10,000 exotics, the whole of which might be acclimatized here, and, in addition, we may reasonably expect to acclimatize many plants and fruit trees which could not flourish beneath the withering effects of a British climate. Victoria possessing an average temperature at least 10° Fahr. hotter than England, would be found a more congenial climate for the acclimatization of plants, the indigenous production of climates whose average temperature is as much in excess of Victoria as that of Victoria is to England. When we are informed, on the authority of the *Société Zoologique d'Acclimatation*, that "green and red cabbage, onions, and parsley are from Egypt, beans from India, melons from Africa, lemons from Media, peaches from Persia, plums from Syria, &c.," we may with good reason hope to acclimatize the orange, castor-oil plant, &c., originally from India, especially when we know that several plants which grow to perfection in England are also from India.

Acclimatization
of animals.

In the animal kingdom, too, who can tell the vast benefits we are likely to derive from the introduction and successful acclimatization of the "alpaca," the South African "eland," and the "forty-two species of tropical

* See Article on Antimony in Appendix.

Indian deer," which the enterprising English expect to acclimatize in England—a climate so widely different from tropical India; may we not, with much greater chance of success, acclimatize these animals in Victoria, in conjunction with the camel, dromedary, and regal koodoo. The introduction of the British salmon, and other commercially valuable fish, to the lakes and rivers of Victoria, are likely to be shortly accomplished, and we may yet derive vast benefits from their successful acclimatization, benefits that will bear a favorable comparison to those that have for so many years been obtained from the salmon fisheries of England and Scotland.

The vegetable productions of Victoria, which are already produced in good average crops, will be considerably augmented by irrigation; this will naturally follow the storage of water, now occupying some of our amphitheatres and gullies in the shape of reservoirs. This subject is still further engaging the attention of the public mind in the contemplated water supply to the gold-fields. Irrigation.

Without entering into particulars of the vast increase likely to take place in our crops, from a good system of irrigation, we may safely anticipate a general increase of at least 50 per cent. in our agricultural and horticultural products, where irrigation can be successfully applied. A considerable increase will also take place from an improved system of farming, which we may expect from a reduction in the cost of farm labor, the application of machinery for the same purpose, and of manure (hitherto too much neglected) to enrich the soil and increase the produce. It will be seen, from the list of "raw materials" produced in Victoria, how much our success, as a manufacturing people, depends upon the economical production of agricultural produce; but even supposing we produced abundance of raw materials at a cheap rate, we must also possess cheap labor and good machinery for the successful conversion of such raw produce into manufactured articles used in the every day purposes of life.

The greatest drawback to our manufacturing interests in 1852, 1853, and 1854, was the high price of labor, the demand having generally exceeded the supply for both skilled and unskilled labor; this has been the chief cause of the enormous rents demanded by the proprietors of household property, who have naturally demanded a rental of from five High rents.

to ten years' purchase, simply because they could generally dispose of their capital to equal advantage in other pursuits.

The great demand for artificers since 1854 has been upheld and maintained by the vast sums of money annually paid for the erection of our public edifices, the permanent construction of which might have been judiciously postponed for a few years, when such a fall in the cost of the labor required may be reasonably expected as would reduce the cost of the permanent public buildings to at least one-third less than their present cost. This reduction in the cost of our public buildings is the more important, when we consider that dressed bluestone often forms a prominent feature in their construction, which costs twelve times as much to work as dressed freestone costs in England. By waiting a few years we should have had an opportunity of testing the durability of our sandstones, which only cost one-third as much to work as bluestone, besides being of a more suitable color for architectural purposes. The same remarks apply to our Government railways; many of the bridges and viaducts of these railways being constructed chiefly of bluestone, and partly of fine dressed bluestone, in most instances crossing pastoral roads and streamlets, to be admired by our cattle and their stock-riders, our sheep and their shepherds, the only class of animals likely to visit them for many years to come, since they are far removed from the "busy haunts of men."* It is by such means we have upheld the unreasonable demands, and have been dictated to by the *tyrannical* class of operatives in Victoria.

Before any important manufactory can be established in Victoria, a very large outlay would be required for suitable buildings, and from one-half to two-thirds of this outlay would have to be paid for labor required in the buildings.

During the years 1852, 1853, and 1854, although Injurious effect of trades unions. the wages of artificers were higher than they have been since, it was simply the result of the great demand for such labor; but since then the various trades' unions have endeavored to maintain these high rates of wages, although the demand in consequence of such exorbitant rates has been

* Since writing the above, now nearly a year since, I find a growing disposition to dispense with fine-dressed bluestone on our Government railways, and otherwise to economise as much as possible.—C. MATEs, June 24, 1861.

gradually falling off: the result has been most disastrous to themselves and to the public generally, who cannot avail themselves of their services, but would rather allow their capital to accumulate in the banks until a more favorable opportunity occurs for investment. From the evidence given before the Tariff Committee* it appears there is a great want of employment among all classes of artisans, and, as it appears to me, from the very same cause, viz., a disinclination to work for less than a certain rate of wages which they consider they are justly entitled to, but at the same time admit that without an import duty of about 25 per cent. they could not compete with imported manufactures. This dearth of employment is not confined to manufacturing operatives; it also extends to artificers, such as masons, bricklayers, plasterers, carpenters, &c., not more than one-half of any of these trades' union operatives being constantly employed at their trades; the consequences being that they are poorer as a body than if they worked for two-thirds of their present fixed rate of wages, and were all of them fully employed—therefore the present assumed high rate of wages is really not the result of a legitimate demand.

All classes of artificers, although refusing to be employed at per day for less than a certain rate of wages, will nevertheless take piece-work at such a price that they cannot possibly earn more than one-half the wages they profess to work for, unless, as is generally the case, they work harder at piece-work: thus ignoring in practice the principles they profess, besides deceiving the public as to the real value of their services. It thus appears that the artisans of Victoria are virtually on strike for the maintenance of a high rate of wages, while the money accruing from the labor of manufacturing imported goods of all kinds, amounting in the aggregate to several millions sterling per annum, is actually kept out of their pockets by their own obstinacy and blindness to their true interests; and what is more humiliating to them is the fact that they must and will ultimately succumb to such a reduction in their wages as will enable them to compete with imported goods which, if they can successfully accomplish, they may depend upon finding constant employment, and will at the close of each year find themselves

Piece work
cheaper than
day work.

* A parliamentary committee which sat during the months of February and March, in 1860.—C. MAYES, June 24, 1861.

better off than they possibly could be while upholding a contest alike destructive to their own interests and that of the country at large.

In the foregoing remarks I have taken it for granted that all classes of artisans will do the same amount of work in a given time under all circumstances; this is only true when they work freely, and believe they are fairly paid, in this respect, as in the army, "one volunteer is worth two pressed men." We see a practical illustration of this important fact not only in

Day-work,

convict labor but also in free labor, when men are employed in road making, and similar work under

Government, they are dilatory and sluggish in their movements, and the expression "Government stroke" has become proverbial. The reason is obvious: the industrious active workman works side by side with others who do not earn half so much as he does, but who are, nevertheless, paid the same for their services; he soon finds that his superior industry is not appreciated, and consequently follows the example of his idle associates by adopting the "Government stroke." "Piece-work" has an

Piece-work.

opposite tendency, because, if a man knows that he must get through a certain amount of work to obtain

a certain payment, he will naturally exert himself more than he would do if paid by time, without regard to the value of the work executed. Piece-work also stimulates emulation, because when a man finds that he is not earning so much as his fellow-workman, whom he regards or wishes to regard as his equal, he will naturally strive to improve, and will exert himself to the utmost in so doing; in fact, the energies and physical endurance of workmen are most fully developed by piece-work. On the contrary, any section of our free and independent skilled or unskilled laborers failing to prevent a reduction in their present high rates of wages, would, if they continued to work, soon show their disappointment by a corresponding diminution of their day's work, unless they could be convinced that they were being fairly dealt with; and it is a difficult task to make men believe they are as well off with lower wages, and that they ought cheerfully to submit to the inevitable laws of "supply and demand."

Advantages of
piece-work over
day-work.

It would be better to introduce throughout the colony in every trade and manufacture the system of "piece-work," by which means every workman,

both skilled and unskilled, would have a direct interest in the quantity of work he got through from day to day and from week to week, while the employer would merely have to measure or otherwise ascertain the quantity of work done, and that the quality of the work was equal to that contracted for. The "trades' unions" of the colony are opposed to piece-work in principle or theory only, but not in practice as before shown. I have every reason to believe that the manufacturing interests of Victoria will succeed in proportion as the "piece-work" system is successfully adopted. The manufacturer will know what he can afford to pay (before he proceeds too far or gets beyond his depth) for a certain amount of work, which he will obtain from workmen who generally prefer their own trade to that of any other, or the great uncertainty of gold-digging, especially if they have been to the gold-fields and been unsuccessful, as most men have been. Supposing the "raw materials" employed in any manufacture to be as accessible here as in England, wages here will be always better than in England, by the difference in the cost of freight, brokerage, and other incidental expenses attending the importation of all kinds of manufactured articles.

Whatever the average earnings of our working classes may be, I am satisfied the same amount of labor will never be expended for daily wages as for piece-work, or for the desperation of anticipation displayed by the generality of our gold-miners.

In spite of the present high rate of wages paid to a few, who are not fully employed, the majority of our artificers and artisans, our laborers and laboring manufacturers, are almost destitute. They find little encouragement on the gold-fields, where the majority of the diggers are as badly off as the unemployed in Melbourne, and where the average earnings of all classes do not exceed 24s. per week by actual statistics.

The destitution in the colony is not confined to the male portion of the population; it is at least as bad, if not worse, among the female portion of our community. From a letter that appeared in the *Argus*, on the 20th June, 1860, I find that between "fifty and sixty persons applied for relief from the St. Peter's Church Poor Fund: seventeen of these were women whose husbands had left them with forty-two children, uncared for and destitute; eighteen were widows with forty-two children." The writer adds, "I do

not believe the above are one-half the persons in distress in this neighborhood, for many do not know that relief can be obtained, and therefore do not seek it." Collingwood is not the only colonial town with destitute women and children; Melbourne and its suburbs, Geelong, &c., also possess a like proportion, the greater part of which might be profitably employed in factories, instead of seeking relief from the parish or a *much worse alternative*, and which, hitherto, seems to have been their *only alternative*.

The high rate of carriage throughout the colony is another serious drawback to the manufacturing interests of Victoria; except in the case of isolated localities, where there is a good demand for an article, the raw materials of which may be procured in the same locality.

Even when our Government railways are opened, they will only benefit that portion of the colony in their immediate neighborhood, at least to any great extent; branch railways or tramways must be continued to other remote localities to obtain a cheap and easy communication. The construction of these railways (permanent though they undoubtedly are), with the present high rate of wages, to say the least of it, is a short-sighted policy; because we cannot reasonably suppose that the present wages (which are less than they were when the railways were let) can be possibly maintained; such an hypothesis is against all precedents, and *it is only on such a supposition, if at all, that an outlay of £8,000,000 could be justifiably expended on opening up 250 miles of the colony.* For the same outlay we might have constructed at least 2000 miles of tramway, which would have opened up eight times the length of country, embracing most of our available districts, and reducing the carriage to at least one-half of the present rates, even by a good macadamised road. Such tramways would have sustained the traffic of the colony for, probably, the next fourteen years, before which time we have every reason to believe our present two permanent lines of railway could have been constructed for £4,000,000 instead of £8,000,000, with the greater advantage of an increase in the immediate traffic, far greater than is likely to be the case in 1862, when our costly railways are expected to be opened.

Tariff Committee.

From the evidence given before the Tariff Committee during the months of February and March,

1860, (by coach-builders, carpenters, and joiners, cabinet-makers, pianoforte-makers, boot and shoe makers, curriers, saddle and harness makers, clothiers, tailors, potters, tobacconists, jewellers, tinsmiths, iron founders, plumbers, farmers, &c.), it appears the colonial manufacturers are unable to compete with imported goods, unless these goods are taxed to the amount of from 10 to 25 per cent; the latter being the duty generally advocated, and which about 80 per cent. of the Victorians would have to pay, in order that they, the minority of 20 per cent., might be enriched.

Most of the above witnesses agree that if they could only successfully compete with imported goods that there would be ample employment for the thousands of skilled and unskilled workmen, women and children, now almost destitute. That our colonial manufacturers should be able to compete with imported goods, and at the same time find employment for the unemployed and destitute, is ardently to be wished, if it could be brought about without taxing one portion of the people for the sole benefit of the remaining portion, and that the minority. It is better, even, that the interests of the few should be sacrificed for the good of the many; although the sacrifice, in this case, is not so great as they, the operative minority, seem to think it is.

The skilled and unskilled operatives of Victoria have been most injuriously affected by the gold-fields Gold-fields. of the colony, and as long as any inducement is held out, either real or imaginary, for men to work at the gold-fields, with the most distant prospect of acquiring vast sums of money by some happy stroke of good fortune, they will not settle down to more legitimate and, as a rule, more profitable employment offered by trade, agriculture, and manufactures. 'Tis true there is a certain amount of uncertainty in all occupations, but in none so great as gold-mining; for although the average earnings of gold-miners, and the gold-fields population generally, does not exceed 24s. per week; it is a well-known fact that the majority of the gold-diggers do not earn probably more than half this, and are consequently reduced to the greatest straits and destitution, which is aggravated by the thought that they have been reckless and extravagant during the short time they were more fortunate; but they will often continue to persevere, after repeated failures, with an amount of industry and

perseverance, which, if applied in any other direction, would have met with certain reward.

If our laboring classes would be contented with an average remuneration of even 30s. per week, for the same amount of exertion that is expended on the gold-fields for an average of 24s. per week, we might successfully compete with imported goods, and there would be ample employment for all classes.

Ask any colonial farmer the value of the unskilled Colonial farm-
ing. unwatched laborer on his farm, and he will tell you he is dear at any price; yet that same laborer has, in all probability, given ample proof of his ability to do a hard day's work at gold-digging, and would exert himself to the same extent for the same farmer, were he employed at piece-work.

Probably three-fourths of the failures in farming here might be traced to the inadequacy of the return for daily labor, as compared with the daily wages received by farm laborers. Another fruitful source of failure in colonial farming may be traced to the system of employing farm laborers at "board and wages." I know one farmer, at least, who has expended a fortune on his land, and has just filed his schedule in consequence, as far as I can ascertain, of employing day laborers and boarding them; he tells me, as a fact, which he can prove by his butcher's bills, that the quantity of meat consumed (or rather made away with) by his men was not less than 3 lbs. per man per diem throughout the year!! Such is the extravagance of men, the majority of whom would not consume one-half this quantity of meat were they to board themselves; nor is this a solitary instance, it is the rule rather than the exception in all similar circumstances.

Were farming to be conducted here in such a manner that every laborer on the farm would have a direct interest in increasing the produce, I have no doubt that farming would be one of the most profitable occupations of the colony. It is for the farmers to decide in what way this change can be brought about, but I have no doubt it could be so managed that unremunerative day labor on a farm should be the exception to the rule.

The "Land Bill" (when remodelled) will do much Land Bill. to bring about a profitable mode of farming, and those farmers will (as a rule) succeed best who are least at the mercy of the day laborer.

The rate of wages is generally considered to be partly regulated by the cost of living, at least this is often the only reason given why wages should not be reduced. What can then be said of those workmen who demand from two to four times the rate of wages paid in England, when the cost of provisions and clothing together are not 10 per cent. greater in Victoria than in England at the present time; or in other words, men can live nearly as cheaply here as in England, with the exception of the item for rent; so that were wages here only 50 per cent. more than in England, our working classes would be better off than the working classes of England.

As most manufactured articles are produced by machinery, the cost of motive power in Victoria must be a primary consideration; but as this forms the subject of another competitive Essay, I will merely call attention to the fact, that motive power can be distributed throughout the colony simultaneously with the "water supply," to which especial attention is now* being directed by the "Central Water Supply Committee," who has sent circulars to all the local bodies on the gold-fields for information as to their requirements, and the advantages to be derived from a copious supply of water in their various districts.

It cannot be too widely known that there are thousands of horses-power now lying dormant in the main pipes from the Yan Yean Reservoir, and that this inexhaustible power could be economically applied any where within a mile or two of the line of pipes, or in Melbourne; but the Commissioners of Water Supply, as if to check manufacturing enterprise, actually charge 4s. per 1000 gallons of water used, while at the same time the water of the reservoir would be vastly improved by being drawn off more copiously, serious proposals having been entertained of emptying the reservoir for this purpose.

Surely the Commissioners of Sewerage and Water Supply would confer a mutual benefit to their returns, and the public generally, by supplying water for manufacturing purposes at least, at say 1s. per 1000 gallons, which might be increased whenever any scarcity was apprehended. Our rivers also afford another source of motive power, not only in their present natural

* September, 1860.

falls, but also in construction of dams in suitable localities, throughout their available length. Were all the water wheels in England to be set aside, she would lose much of her motive power, and consequently her manufacturing prosperity. I might instance the Yarra Falls at Melbourne, where there is at least 1000 horses power continually running to waste in the busiest part of Melbourne. Very extensive mills might be erected over these Falls, without detriment to the river or its traffic;* or the water might be taken in culverts across Flinders-street, or in any other direction, so that after turning several undershot or turbine water wheels, it might again return to the Yarra below the Falls.

From the joint report of Capt. Pasley, R.E., and M. B. Jackson, C.E., furnished to Parliament, I learn that in consequence of the water of the Barwon River at Geelong being unsuitable for supplying Geelong with water, that they propose to construct a reservoir at Buninyong, by which means they contemplate being able to supply both Geelong and Ballaarat with pure water, the line of pipes being taken down the Geelong and Ballaarat Railway; should this bold scheme be carried out, it will afford the same facilities for motive power and irrigation, as is now offered by the mains from the Yan Yean, and generally throughout the colony similar advantage might be taken of the water, not only in its transit but also at its termini. Windmills will also afford another economical motive power, in all cases where its constancy will not be indispensable, as in raising water on to the high banks of rivers (as the Murray), into water holes or reservoirs to be used in summer, for the purposes of irrigation or even for motive power, where considered desirable.

Messrs. Dods and Co., plumbers, &c., of Melbourne, have lately invented and patented a *portable engine* of two horse-power, which can be worked by a half-inch jet of water from the Yan Yean service pipes; an inch service pipe would afford four times the power, equal to eight horses: by such engines many of the manufactured goods now imported might be economically produced in the neighborhood of the Yan Yean main or service pipes.†

* Since the above was written a bridge has been erected over these Falls.
—C. MAYES.

† The *Argus* of the 15th inst., contains an account of "A simple and effective hydraulic machine of four horse-power, erected on the premises of

I consider that some inducement should be offered for the profitable establishment here of manufactories, which would induce experiments to be tried, and investigations made, to convert many of our raw materials into manufactured articles. Premiums.

For instance, let a premium of £1000 be offered by the Government for the first 100 tons of iron produced in Victoria, at 10 per cent. less than it could be imported; also, the same amount for 20 tons of rod and bar steel, made from charcoal iron, manufactured in the colony; also, £100 for a dinner service of delftware, equal to imported; and £200 for a similar service of china or porcelain, and so on with all those articles, the raw materials for which are to be obtained in abundance throughout the colony; the persons claiming the premiums to prove, by creditable evidence, that they have been and can again be produced for at least 10 per cent. less than the imported price of similar articles. £10,000 expended in this manner would, in all probability, cause £100,000 to be expended by enterprising manufacturers in endeavoring to establish manufactories. The gold-fields are particularly favored by the Government, who not only allow puddlers to deluge both public and private property with *sludge*, but also grant large sums of money to clear it away, to make room for more. They also invite premiums for the discovery of new gold-fields, and good building stone, &c., but offer no inducement to the people to establish manufactories, with the exception of passing a Land Bill, which may possibly help to lower the price of our raw materials.

"CIVIL ENGINEER."

September, 1860.

Messrs. Brown and Reid, Collins-street, east." This machine grinds one ton of coffee per day, at a cost for water of less than two shillings per ton. This is the whole cost of the motive power, which is derived from the Yan Yean service pipes.—C. MAYES, June 24, 1861.

NOTE.—In the following Essay I have adopted the alphabetical order observed by Dr. Ure, in his Dictionary of Arts, Manufactures, and Mines; which invaluable work has been my text book throughout.—C. MAYES, June 28, 1861.

THE
ECONOMICAL MANUFACTURES
OF VICTORIA.

ALCOHOL.

Alcohol is the intoxicating principle produced by the vinous fermentation of liquors containing saccharine matter, or sugar. Common alcohol, or proof spirits, contains an equal quantity of absolute, or pure alcohol and water. It may be concentrated by water-bath heat to such an extent as to contain only 11 per cent. of water. In distillation the strongest alcohol is given off by a temperature of 170° Fahr.; and if the water-bath is maintained at that temperature, the vapor will contain 93 per cent. of pure alcohol; if it is raised to 201°, proof spirit, or common alcohol, will evaporate. The main improvement in modern distilleries is in the skilful application of this important principle.

Alcohol may also be concentrated by being suspended in bladders, which possess the peculiar property of giving off water by evaporation, while the alcohol is retained within the bladder; in this manner any spirits below proof may be concentrated to 40° above proof in from six to twelve hours, by being suspended in a hot room: this simple and economical method is well adapted for obtaining alcohol required in the preparation of varnishes; should it be required for medicinal purposes, the bladders can be rendered innocuous by being washed over with isinglass.

Alcohol containing only 11 per cent. of water may also be obtained by adding dry carbonate of potash to any intoxicating liquor, when the spirit at once rises to the surface and floats on the water contained in the liquor acted upon.*

* Dr. Ure.

Alcohol dissolves resins, essential oils, camphor, &c., forming varnishes, perfumed spirits, &c. It is also used for preserving animal substances in our museums, for combustion in spirit lamps, &c.

In 1858 spirits of wine were imported to the amount of £5300, and perfumed spirits to the amount of £13,000. We have here £18,300 paid for spirits consisting chiefly of alcohol, exclusive of £5900 paid for imported cordials.* Taking into consideration that ten shillings per gallon is paid into the customs for all imported spirits, including those now especially under consideration, and that spirits of wine may be obtained from inferior or bad-flavored spirits or wines, or from a fermented decoction of injured corn or grain, or damaged sugar, it seems more than probable that common alcohol, or spirits of wine, with spirits suitable for perfumed spirits, and cordials, may be obtained in this colony with advantage to the manufacturer.

Alcohol obtained from the above sources may be easily freed from the *fusel oil*, the property that imparts its peculiar flavor; which, although not objectionable in the preparation of varnishes, or preserving animal substances, or for spirit lamps, would render it unfit, until purified, for medicinal purposes, perfumed spirits, or cordials.

AMMONIA.

By referring to the list of animal productions given in the preface it will be found that ammonia is produced from blood, flesh, horns, hoofs, woollen rags, hair, waste and scrapings of hides, leather, &c. These are distilled in large iron retorts in France, the charcoal produced from them being made into Prussian blue. See "ammoniacal liquor," under article "gas."

APPAREL AND SLOPS.

Apparel and Slops were imported here in 1858 to the amount of £460,136. From the evidence given before the Tariff Committee in February last, I learn that "the whole of the imported apparel, or clothes, are of an inferior description, and that in consequence of tailors, vest-makers, &c, in England, working for one half the

* In 1859 we imported cordials, spirits of wine, and perfumed spirits, to the value of £213,297.—C. MAYES, June 24, 1861.

wages paid here, that this description of goods cost 25 per cent. more than those imported; that we make the better class of goods because they are not to be obtained by importation. Silk vests are imported from China, Singapore, &c., at very low prices; with all these drawbacks slop goods have been made here by women and sewing machines at such a price as to compete with similar imported goods; for our needle-women are glad to earn twopence per hour, which is at least double the pay at home. They are also making slops in Sydney for the New Zealand market."

"Womens' apparel is also made here by sewing machines at less than half the cost of hand labor.* Silk bonnets are always made in the colony, because the drapers cannot get them imported to order." It would appear from the above that our importations of wearing apparel to nearly half a million per annum are likely to be rapidly reduced, since the charge for clothes made in the colony are approximating to the price of those imported.*

ALE.

We may apply the term "ale" to the whole of the liquor imported here under the head of "beer," which in 1858 amounted to £302,788 for bottled beer, and £273,136 for draught beer, together equal to £576,924. Judging from the magnitude of the importations, the colonial manufacture of malt and ale are likely to become of vast importance to our brewers and the public generally.†

ALE AND BEER.

Hops.—We may with reason expect in a few years to find sufficient hops grown in this colony to supply our wants without importing them; but, as this subject belongs to agriculture, I will proceed with the important fact that hops imported from Great Britain, from the efficient manner in which they are packed

* On referring to the imports for 1859, I find that apparel and slops were imported to the value of £588,654, which shows an increase of £128,518; this may be owing partly to an increased demand and partly to small stocks on hand at the close of 1858. I have no reason whatever to suppose that the colonial manufacture has fallen off.—C. MAYES, June 25, 1861.

† In 1859 we imported bottled beer to the value of £269,327, and draught beer to the value of £395,292. Together equal to £664,619. Showing an increase of £87,695 as compared with 1858.—C. MAYES, June 25, 1861.

(by hydraulic pressure), and the care taken to preserve them from the effects of the voyage, arrive here perfectly uninjured by transit. "The essential oil in particular, the basis of their flavor, is preserved without decay." The first operation in brewing is—

Mashing.—"The quantity of water to be employed for mashing, or the extraction of the wort, depends upon the greater or less strength to be given to the beer. The seeds of the crushed malt, after the wort is drawn off, retain still about thirty-two gallons of water, and in the boiling and evaporation from the coolers forty gallons of water are dissipated from every quarter of malt, constituting seventy-two gallons in all, either absorbed by the *grains* or evaporated. The quantity of extract (or solid matter), per barrel weight which a quarter of malt yields to wort, amounts to about eighty-four pounds; this is ascertained by the saccharometer, and is the result of *three extracts*. The wort is now transferred into the copper and made to boil as soon as possible, and until it begins to boil the air should be excluded by some kind of cover; the hops are now added, and are boiled several hours, a longer time for the ales than for the beers; two or three hours are deemed long enough in many well-conducted breweries: if they are boiled more than five or six hours they lose a portion of their fine flavor. The quantity of hop to be added to the wort varies according to the strength of the beer, the length of time it is to be kept, or the heat of the climate where it is intended to be sent." For the strongest ale the rule in England is to take one pound of hops for every bushel of malt.*

Cooling.—The common cooler is a square wooden cistern, about 6 inches deep; this is not more than half filled with the boiling wort, which, when it reaches the cooler, is about 200°; here it is cooled down to about 60° for the fermenting tun. The cooling should be as rapid as possible to prevent acidity, for which reason, *refrigerators*, or machines for rapidly cooling the hot wort, are generally used, with great advantage. The cooling takes place most rapidly at a temperature of from 50° to 55°; if it approaches the freezing point the steam will not so readily rise from the surface of the cooler. The frosts of England are therefore of no advantage in *cooling the wort*. It is also found that the cooling takes place more rapidly under a dry atmosphere

* Dr. Ure.

than a moist one of the same temperature : in this respect Victoria has certainly the advantage over England. For six months in the year our mean temperature does not exceed 60° ; viz., from April to October.

Fermentation of the Wort.—As a rule it is well known that the best ales are those fermented and ripened at the lowest temperatures. "The ale of Preston Pans is the best substitute for wine which barley has hitherto produced." "The Scotch brewer does nothing during four of the summer months." Taking the mean temperature of summer at Preston Pans to be 60° , the same as at Dublin (being 2° lower than at London), it does not seem reasonable to suppose that the Melbourne brewers can brew good ale during the summer, when the average temperature is stated to be about 69° .

"The greater or less rapidity with which the worts are made to ferment has a remarkable influence upon the quality of the beer, especially in reference to its fitness for keeping." "The slower, more regularly progressive, and less interrupted the fermentation is, so much better will be the product." "The higher the temperature of the wort the sooner will the fermentation begin and end, and the less is it in our power to regulate its progress."

These extracts from Dr. Ure's article on "Beer" will show the difficulty (if not impossibility) of brewing good ale in this colony during the summer months.

Ripening.—This is a process now very little attended to since the brewers find it more advantageous to sell their beer when new, and consequently mild. "Hence six weeks is a long period for beer to be kept in London, and much of it is drunk when only a fortnight old." Thirty or forty years ago *good hard beer* was the boast of the day; but since then the English taste has altered to such an extent, that publicans must "draw it mild" to suit their customers, although there is always plenty of hard or old ale to be obtained in England by those who prefer it. This is not the case in Victoria, for, with the exception of the bottled ale imported from England, and which has generally been pretty well ripened by the voyage, (or was probably ripe when bottled or shipped in draught), we have nothing but *very mild* colonial beer, which is not worthy the name of ale.

The color of beer depends upon the color of the malt, and the time it is boiled. The malt is deteriorated by being over dried,

the palest, or least dried, making the strongest ale; and the darkest, or highest dried, the inferior beers, or porter.

If ale is brewed in this colony in the eight coolest months in the year, it might be properly kept and ripened throughout the summer, supposing suitable underground storehouses or vaults were constructed for this purpose. It is surely not so difficult to keep ale cool as it is to keep ice from melting; and yet large quantities of ice are imported and kept throughout the summer in Melbourne. If this colony ever becomes a wine producing colony, its wines must be kept throughout one or more summers to acquire that age and ripeness essential to the best wines: so it is with ale. If it is desired to produce colonial ale equal to either the best Burton or Scotch ales, I believe that nothing more is necessary than that it should be made with the same proportion of pale malt and hops of the best quality, the wort cooled down to and fermented at the proper (well-known) temperature, and then transferred to ripening tuns, to be kept at a low even temperature throughout one or more of our Australian summers.

There is always likely to be a great demand for cheap and mild, or new colonial beer; and I have no doubt also that if first-class Australian ale was to be manufactured here, it would tend materially to lessen the importation of English and Scotch ales, which are universally preferred throughout Victoria to our present colonial beer, and that simply on account of their superiority of flavor, strength, and wholesomeness.

BEER.

This is a name given not only to a fermented infusion of malt, flavored with hops, but also to a fermented infusion of sugar, potatoes, carrots, turnips, beetroot, treacle or malt made from maize, wheat, oats, beans, or any other grain containing an adequate quantity of starch. If either of the above kinds of malt are used the process of brewing is the same as with barley malt. It is understood that if any of the above articles are used for the manufacture of beer, that they are flavored with hops, otherwise the infusion would be more properly called wine.

When either potatoes, carrots, turnips, or beetroot are used, they are boiled in water and mashed into a pulp; this pulp is mixed in the copper with corn meal, a proper quantity of water being added, the whole is boiled together for a short time, when

the hops are added, and the boiling continued for about eight hours; this wort is allowed to cool in the usual way, and fermented with the addition of yeast. "The celebrated Strasbourg ale is made from mashed potatoes mixed with about a tenth of their weight of finely ground barley malt and some water; this mixture is exposed in a water bath to a heat of 160° Fahr. for four hours, whereby it passes into a saccharine state, and may then be boiled with hops, cooled and properly fermented into good beer."*

Although potatoes were imported into Victoria in 1858 to the amount of £107,500, I have known several instances of good crops of potatoes being left to rot in the ground simply because the producer had no use for them, and they were too far from a market (on account of very bad roads) to pay for cartage. Beer is made in Germany from a mixture of barley-malt and beetroot-sugar, also from a mixture of barley-malt, potatoes and beetroot-syrup, and another kind from refined beetroot-syrup alone.

"Considerable interest among men of science, in favor of the Bavarian beer process, has been excited ever since the appearance of Liebig's *Organic Chemistry*. In the introduction to this admirable work, he says: "The beers of England and France, and the most part of those of Germany, become gradually sour by contact of air. This defect does not belong to the beers of Bavaria, which may be preserved at pleasure, in half-full casks as well as full ones, and without alteration by the air. This precious quality must be ascribed to a peculiar process employed for fermenting the wort, called in Germany *untergährung* or fermentation from below, which has solved one of the finest theoretical problems." Dr. Ure then explains, at great length, the chemical processes of this manufacture, which, on account of the difficulty in preventing ale or beer from turning sour in a hot climate, might probably be pursued here with great advantage. He says, "Neither the richness in alcohol, nor in hops, nor both combined, can hinder ordinary beer from getting tart, unless it is preserved in large ripening tuns, well closed, well filled, covered with sand on the top, and kept at a low even temperature;" but, even with these precautions, it will not keep in small casks, on account of the transpiration of air through the pores of the wood, the surface being much larger, in proportion to the quantity of ale in the

* Dr. Ure.

small cask, than it is in the immense ripening tuns made to hold 5000 or 6000 barrels. "The grand secret of the Munich brewers is to conduct the fermentation of the wort at too low a temperature to permit of the acetification of the alcohol." "The vaults in which the beer is fermented, ripened, and kept, are all underground, and mostly in stony excavations called *rock cellars*." * * * * "In December and January, (mid-winter), after the casks are charged with the summer or store beer, the double doors of the cellars are closed, and lumps of ice are piled up against them, to prevent all access of warm air. The cellar is not opened till next August, in order to take out the beer for consumption. In these circumstances, the beer becomes transparent like champagne wine; and since but little carbonic acid gas has been disengaged, little or none of the additionally generated alcohol is lost by evaporation."*

Lager Beer.—"In Bavaria, where this manufacture is carried on under Government inspectors, a brewing period is prescribed by law, which is, for the under fermenting Lager beer, from Michaelmas to St. George's day."*

About a year ago I received a circular, relating to Lager beer, from some party who had started a manufactory in Melbourne, on a small scale, stating the peculiarities of this beer, its price, &c., since which, I have heard nothing of it. It certainly seems strange, that among so many Germans, that one Lager beer brewery should not be maintained.

Porter and Brown Stout differ from ordinary beer, chiefly in the addition of the following ingredients, viz.: about two per cent. of kiln-browned malt, mixed with ordinary malt; 12 cwt. (for 180 barrels) of sugar, fused over a fire, into a dark, brown, or black syrupy mass; about three times as much hops as for beer, and 10 quarts (for 180 barrels), of *calfini*, a preparation made with the oil distilled from the outer bark of the birch, mixed with spirits of wine.*

Sugar Beer, as it is sometimes made in this colony, is a poor, sweet drink, but when properly mashed with hops, fermented, and ripened at a low temperature, it is of a quality superior to any colonial beer, in both flavor and wholesomeness, I have hitherto tasted. It can be made of any strength, according to the quantity

* Dr. Ure.

of sugar used ; a beer of ordinary strength requires 1 lb. of sugar, and 1 oz. of hops to the gallon ; this may be increased to 2 lbs. of sugar, and 2 ozs. of hops per gallon, for a strong, heady, bitter beer. If this beer be kept for six months, at a low temperature, (being hotted at two months), it will be found to be clear, sparkling, and fine flavored, and inferior only, to the best English ales. I write this from actual experience, having drank such beer for the last seven years.

The number of breweries in Victoria, in 1858, is stated, in our Blue-book, to have been 55 ; of which number, 10 were to be found in Melbourne and Collingwood.*

I have no means of ascertaining the quantity of beer brewed, or even the quantity of malt used, because, independently of the quantity of malt imported, there were, and are now, several malt-houses in the colony ; neither can we ascertain the quantity of sugar used, even by those who profess to brew from malt and hops alone. Mr. Greeves, M.L.A., stated in the House, on the 20th July last, that "750 tons of sugar per annum, were said to be used in one district alone." Mr. Howard, M.L.A., also stated, the same evening, when introducing the proposed Beer Bill, that "in Sandhurst, two hogsheads of beer were brewed for every man, woman, and child, per annum." Reckoning 1 cwt. of sugar to be used in the manufacture of 2 hogsheads of sugar beer, which, without any other saccharine matter, would produce a light, palatable, wholesome drink ; 750 tons would supply a population of 15,000 with 2 hogsheads each. According to Dr. Ure, sugar should yield its own weight of proof spirit, when properly fermented : at this rate the last-mentioned beer would contain 5 per cent. of absolute alcohol, and be equal, in strength, to brown stout.

Colonial Beer.—In June, 1860, an attempt was made by the protectionists of Victoria to impose a tax upon imported ale, with the view of encouraging the manufacture of colonial beer. This movement called forth a vigorous article in the *Argus* in condemnation and abuse of colonial beer, which was stated to be anything but what our colonial brewers would wish it to be

* In 1859 there were only forty-six breweries in Victoria, thirteen of which were in the county of Bourke. See *Archer's Statistics for 1859*.—C. MAYES, June 28, 1861.

called, or even known by. As was to have been expected, this article called forth a reply by one of the leading brewers in Melbourne, wherein he states "that he feels assured the leading journal of the colony would not willingly or wilfully promulgate statements at variance with fact, and calculated not only to produce an unpleasant feeling in the public mind but materially injure a rapidly growing and important branch of colonial industry." He also says: "As one of the largest manufacturers of colonial ale, I respectfully invite you, or any scientific gentleman, to test my manufactures." And further: "I utterly deny that any unwholesome ingredient is used in the manufacture; the most common description of colonial ale which is manufactured is as pure as beer is possible to be, and being less fermented than that which is imported contains a smaller alcoholic per-centage, to say nothing of those deleterious ingredients which it is generally believed are introduced into imported beer to enable it to stand the voyage." The former part of this last statement ill accords with the latter part, for although this brewer may not use any unwholesome ingredient in his brewery, it does not follow that others are equally conscientious; and, on the other hand, he does not scruple to allude to "those deleterious ingredients which it is generally believed are introduced into imported beer to enable it to stand the voyage;" from which we might infer that no genuine English ale ever reaches this colony in a sound state. I would refer to one of the greatest scientific authorities on brewing, viz., Dr. Ure, to bear me out in the statement, that no deleterious ingredient is necessary to preserve beer, and also that even the best English ales cannot be kept sound in ordinary casks except at a low temperature, which, I imagine, may be found even in the depths of a well closed hold of a ship while crossing the line. I have no opportunity of ascertaining the quantity of *pricked* or sour beer landed in Melbourne, but I have no doubt it will be found larger in proportion in draught than in bottled ale, on account of the porous nature of the wood forming the casks. W. Hull, Esq., J.P. (in his evidence given before the select committee on the "Licensed Publicans" Act, in June, 1860) says, "Ale is damaged on the voyage or after being landed;" he also adds, "but that ale will make splendid vinegar." And again, "All the vinegar I have used at my house for the last two years I have made myself from this beer." So far so good, but he also

states, "I believe that those *pricked* (sour) beers are used by the brewers here to get up their own making more quickly; they have not capital to hold;" adding, "Beer that is *pricked*, however much it may be *doctored* by the publican, nauseates the palate." This I conceive to be important evidence, inasmuch as it seems to me to be one of the reasons that some of our colonial beer has the peculiar flavor by which it may generally be distinguished, viz., a sweet flavor or mildness from insufficient fermentation, coupled with a slight acid taste, either from mixture with *pricked* beer, too rapid fermentation in a heated atmosphere, or carelessness in *mashing*, whereby part of the wort is converted into vinegar. Pricked beer cannot be restored to its original quality, and it will also impart an unpleasant flavor to mild beer if mixed with it; indeed, this is the very system that is pursued in converting alcoholic drinks into vinegar, viz., *by the admixture of vinegar*, which accelerates the acetous fermentation, in the same manner that yeast acts upon *worts* in the vinous fermentation. It should be borne in mind by colonial beer drinkers, that mild or sweet colonial beer, even if a little tart, can, when bottled or otherwise securely corked, be brought round by the secondary fermentation of the undecomposed (gluten and starch, or) saccharine matter, in a genial temperature, to a flavor and strength superior to any it had previously assumed on account of imperfect fermentation in the first instance. The brewer before alluded to in another part of his letter in the *Argus* says, "No expense being spared in machinery or supervision, or to obtain the necessary ingredients, what is there, I would ask, to prevent as good and wholesome a beverage being manufactured here as in England?" In answer to this important question I would refer the reader to Dr. Ure's remarks under the head of "Fermentation of the Wort;" and also to the process of "Ripening;" and lastly, to the grand secret of the Munich brewers, as stated under the head of "Beer."

The *Creswick and Clunes Advertiser* of June 29th, 1860, gives an account of a brewery at Cabbage-tree flat; it states, "The brewery, 48 feet by 14 feet, is three stories high, the *cellar ten feet underground*, boarded, and everything complete with working puncheons, troughs, &c. A constant supply of pure water enables the proprietor to keep up a moderate temperature even in the hottest weather." I believe that such cellars, with a plentiful supply of cold water to encircle the fermenting and ripen-

ing tuns, are among the chief conditions necessary to improve the quality of colonial beer as now manufactured.*

BISCUITS.

I find that in 1858, 92 tons of biscuits were imported and valued at £6716. This refers exclusively to ship or navy biscuits.† Previous to 1831 ships' biscuits were made by hand, since then by machinery invented by T. T. Grant, Esq., of Gosport, in England. Dr. Ure, after describing the method of making ships' biscuits both by hand and machinery, says, "We have seen that 450 lbs. of dough may be mixed by the machine in four minutes, and kneaded in five or six minutes; we need hardly say how much quicker this is than men's hands could effect it. The biscuits are cut out and stamped sixty at a time instead of singly: besides the time thus saved, the biscuits become more equally baked by the oven being more speedily filled." The comparative expense is thus stated: "Under the old (hand) system, wages, wear and tear of utensils, cost about 1s. 6d., per cwt. of biscuit; under the new system (by machinery) the cost is 5d." He further adds, "The advantages of machine-made over hand-made biscuits therefore are many; quality, cleanliness, expedition, cheapness, &c." The biscuits imported here in 1858 cost us about 74s. per cwt.: reckoning the cost of manufacture here at 1s. 8d., or four times the cost in England, and the weight of the biscuits in flour at 23s. per cwt., we have a total cost of 24s. 8d., or one-third the imported price, leaving a profit, one would suppose, amply sufficient for any amount of capital expended in the erection of a suitable manufactory furnished with the best machinery. From the colonial Blue-book for 1858 I find there were five biscuit manufactories in Victoria in that year, three of which were in the county of Bourke. It would appear from this that there must be a great

* I would here call the attention of the scientific brewers of Victoria to the process of cooling the wort, that they may ascertain, by actual trial, whether it is better to use fans or cold water refrigerators. It appears to me that fans are objectionable, because "the impregnation of the saccharine liquid by the oxygen of the air is the object aimed at in the manufacture of Vinegar," which see.—C. MAYES, June 25, 1861.

† In 1859 we imported 114½ tons, valued at £9879, or about 80s. per cwt.; shewing an increase in quantity and price as compared with 1858.—C. MAYES, June 25, 1861.

consumption of biscuits in this colony, for we find only ten tons exported, at 56s. per cwt.*

BRANDY.

The quantity imported into Victoria in 1858 amounted to no less than £447,546.† The best brandy is distilled from wine, and consists chiefly of alcohol or spirits of wine, each variety of wine producing a spirit peculiar to itself in flavor, which is due to an essential oil so powerful that a few drops of inferior oil are sufficient to taint a pipe of fine flavored spirit. Brandy is also distilled from a *wash* made from cherries, sugar cane, rice, corn, or potatoes, each kind having its own peculiar flavor by which it may be distinguished by *connoisseurs*; but flavorless spirits, as corn spirits sometimes are, may be converted into a factitious brandy by diluting the alcohol down to *proof*, then adding crude winestone dissolved in water, a little acetic ether and French wine vinegar, some bruised French plums, and flavor stuff from cognac; the mixture is then distilled with a gentle fire in an alembic furnished with an agitator. This new product may be colored with nicely burnt sugar, and roughened in taste with a few drops of tincture of catechu or oak bark; it will nevertheless be as wholesome as alcohol in any shape can ever be, and free from all deleterious drugs.‡

Latterly great attention has been directed (chiefly through our daily journals) to the cultivation of the vine, and the manufacture of wine in this colony.§ From the great success which has attended its partial manufacture in New South Wales, coupled with the opinion expressed by the first authorities in the colony, we may reasonably expect that Victoria will in the course of a few years become noted as a wine producing colony, if the restrictions as to distillation are removed, or even moderated; it will also

* In 1859 there were six biscuit manufactories in Victoria, four of which were in the county of Bourke.—C. MAYES, June 28, 1861.

† In 1859 we imported brandy to the value of £422,790, shewing a decrease as compared with 1858, of £24,756.—C. MAYES, June 25, 1861.

‡ See Dr. Ure's *Dictionary*.

§ It may also be worth our while to cultivate and dry figs for the manufacture of brandy, &c. "The annual production of figs in the province of Algarve in Portugal averages 11,238 tons, of which 2496 tons are consumed in the country, chiefly for making brandy, the price of which varies from 10 to 14 francs per cwt." See the *Argus* of November 14th, 1860.—C. MAYES, June 29, 1861.

simultaneously become as noted for its superior brandy as France now is, *i. e.* if its wines are equal to those of France, which we may reasonably expect they will be.

Illicit Distillation.—Even without wine or wine lees, an illicit distillation is carried on rather extensively throughout the colony, which leads me to suppose that if licenses were granted, and say one-half the duty on imported spirits, or 5s. per gallon was to be imposed upon all spirits distilled in the colony, subject to the test (as to strength and purity) of the revenue officers, that an important manufacture would spring up which would tend materially to reduce the enormous sum of nearly half a million sterling now paid for brandy alone, to say nothing of other spirits, such as gin, rum, and whiskey, amounting together to about £700,000 annually, expended by the Victorians, not on pure spirits, or even factitious brandy made from wholesome ingredients, but for the worst description of spirits, chiefly known as brandy, which, judging from the bad name it has got, is not even wholesome, and is probably made from damaged grain or bad potatoes, the bad flavor of which is due to an essential oil before referred to, called by the Germans *fusil oil*, and which may be separated from the spirits by a very simple process, rendering bad spirits almost flavorless and innocuous. In proof of the fact of illicit distillation being carried on in the neighborhood of our gold-fields, I will quote the evidence given by Mr. W. Jackson (a publican of Ballarat,) before the Select Committee on the Licensed Publicans Act, on the 22nd February, 1860. He then stated "that illicit spirits could be obtained at Ballarat from 10s. to 15s. per gallon, and from fifteen to twenty degrees over proof; it was sold as brandy, and could not easily be distinguished from cognac; and that it was made from rice, malt, or other grain." It was also stated to the same committee by William Hull, Esq., J.P., as to the quality of imported brandy that "Two-thirds of the brandy that comes here as cognac is made from a wash of potatoes in England. It (the brandy) is shipped to France or Belgium, where it is bottled and marked as Martell's, &c.; it is then shipped out here as the genuine article." He also states in clause 1401—"I endorse the remarks that Mr. King made a few minutes ago, that many hundreds of thousands of gallons are here at the present moment (June 12th, 1860) that will not be taken out of bond." * * * "It will remain until

it has *eaten its head off* in storage. It is not fit for consumption: the best thing that could be done with it would be to destroy it." He also mentions "that to prevent such imports in future, the revenue officers might be empowered to test and gauge all imported spirits, and refuse to pass or allow to be landed all of inferior quality."

Before the Government acted upon such advice as this, it would be perhaps advisable to put samples of these inferior spirits into the hands of their analytical chemist, that they might know what they really consist of, for unless the information furnished by Dr. Ure (in his *Dictionary of Arts and Manufactures*) is not to be relied upon, the objectionable qualities of inferior spirits are due, as I have before stated, to an essential oil which may be separated from the pure alcohol, the basis of all spirits distilled from fermented liquors or washes. If these bad spirits (which should yield to the revenue at least a quarter of a million sterling for duty alone) should be found incapable of being purified at a reasonable cost, they might probably be used for other purposes, such as for consumption in spirit lamps, or for varnishes, and other purposes to which alcohol is applied; but since "this noxious substance *fusil oil* is more volatile than alcohol, it may be drawn off by distillation in a concentrated state." The potato *fusil oil*, which is the kind we have to deal with, supposing Mr. Hull's evidence to be correct, "has at the first impression in its pure state, a strong, not disagreeable smell, which afterward becomes extremely nauseous, and excites an acrid burning taste. The inhalation of its vapor causes a feeling of oppression and vomiting." In consequence of the high price of alcohol in Great Britain, it is smuggled under various disguises; sometimes it is mixed with oil of turpentine, at other times with wood naphtha, or wood vinegar, coal naphtha, &c., from all of which deleterious mixtures it is freed by distillation and other processes.* I therefore see no reasonable obstacle to the purification of the immense quantity of inferior spirits now in bond, either by its importers, or other enterprising citizens purchasing it for this what appears to me to be a very laudable object.

Dr. Ure, in treating of distillation, says, the best "means hitherto discovered for depriving bad whiskey of its nauseous

* Dr. Ure.

smell and taste is to pass it through well burned and coarsely pulverised charcoal." This is distributed in layers alternating with layers of sand, the sand being separated from the charcoal by close canvas; casks or cylinders are filled with these layers and the spirits forced through. It has been found with very crude spirits that eight successive cylinders were required to deprive them entirely of the rank flavor. As the bad flavor of all spirits are caused by the presence of an essential oil, as before stated, it follows that they are alike susceptible of purification by filtration through charcoal, &c.

By an approximate summary furnished by the Registrar-General, on the 26th July, 1860, it appears that 477 gallons of brandy were made in the colony during the year ending 31st March, 1860.

BRICKS.

Bricks are of at least two distinct classes, viz., fire-bricks made from fire-clay or artificial substitutes for fire-clay, and common bricks or bricks calculated to withstand exposure to the weather only; in addition to this last necessary quality, fire-bricks will also withstand a furnace heat for at least three months. In consequence of the great improvements in the manufacture of colonial bricks which have gradually taken place since about 1853, the importation of bricks has gradually decreased, the quantity imported in 1858 being only 510,000, at a prime cost of about £6 5s. per 1000, and these were fire-bricks.

Fire-bricks, or bricks made expressly for furnace work, have not (as far as I have been able to ascertain) hitherto been manufactured in the colony to any great extent. That suitable clays exist I have not the least doubt; a natural compound of silica or sand and clay in about equal proportions, and free from lime, magnesia, or other flux, is the best fire-clay, and such clay exists in all coal-fields, those of Cape Paterson, Western Port, &c., not excepted. If the alumina or clay is in excess, and contains oxide of iron, as most common clays do, care must be taken "not to add too much siliceous sand, or a fusible compound will be produced." To avoid this, it is common to add waste fire-bricks, or burnt clay, or common brick rubbish, properly ground and mixed with the clay as a substitute for the sand; the pipe-clay of Bendigo has been used in this way with success.*

* See *Colonial Mining Journal* for September, 1859.

As manufactures requiring furnaces increase in this colony, fire-bricks will come into more general demand, as in the lining to brick, tile, lime, cement, or pottery kilns, the lining of cupolas for smelting iron, tin, and other metals, for coke and common ovens, setting retorts for gas-works, and boilers for steam-engines, &c., &c.; so that it is really important that this branch of our manufactures should receive greater attention than has hitherto been bestowed upon it.

Economy of Brickwork.—In consequence of the great expense of working "bluestone" and granite (the most durable of our building stones) and the fact of Bacchus Marsh and Darley stones being liable to exfoliation from the presence of sulphate of soda and other salts which permeate their entire substance to a greater or less extent, it seems more than probable that our building stones will be in many instances superseded by the manufacture of good bricks, especially where durability and economy are the primary considerations. It is a well-known fact which has been repeatedly proved by experiments, that brickwork is stronger than stonework, and that *brickwork in cement is stronger than either*, and yet brickwork in cement is only half the cost of dressed bluestone masonry, supposing the materials to be carted the same distance in both cases. I believe that at least £500,000 out of the £8,000,000 to be expended on our trunk lines of railway might have been saved if brickwork had been substituted for bluestone masonry in all cases in which suitable bricks could have been obtained as near to the work as the good bluestone quarries were; as it is and has been up to the present time, no trouble has been taken to search for suitable brick-earth in the neighborhood of great public works, although in many instances it would effect a saving of one-fourth of the total outlay.* The greatest difference in the relative cost of brick and stone work is in those cases where considerable labor is bestowed upon moulding the stone work; this is saved in the brickwork by the bricks being moulded (before they are burnt) in the process of their manufacture. The whole process of brickmaking I consider to be of such vast importance in developing one of the greatest resources of the colony, that I append a few facts on the principles and practice of brickmaking adapted to the requirements of the colony, the result of actual

* This was written in July, 1860.—C. MAYES, June 25, 1861.

colonial experience, and which may be considered under the following heads, viz. :—1. Brick-earth ; 2. Weathering and Grinding ; 3. Tempering ; 4. Moulding ; 5. Drying ; 6. Burning.

1. *Brick-earth*.—The success of brickmaking depends mainly on the quality of the brick-earth used, for unless it is naturally good, or can be made so by the mixture of sand or other suitable material at hand, the greatest care in the preparation, moulding, and burning will not compensate for the inferiority of the raw material. Alumina or pure clay is or should be the principal constituent of brick-earth ; but if the brick-earth consists wholly of pure clay, or clay containing not more than 30 per cent. of sand, it is useless for brickmaking, since it will not dry (even with the most careful treatment) without cracking, on account of the great shrinkage ; it is also refractory in burning, the most intense heat being insufficient to bind the particles composing the brick together. As a rule it may be stated that bricks that are *easily dried are easily burnt* ; but this property is not always a good one, because it is sometimes the result of the opposite extreme, and proves that the brick contains too much sand (like the Prahran bricks). The best brick-earth contains about equal proportions of clay and sand, and when these two ingredients are the only constituents of brick-earth, as in some fire-clays, it produces a most excellent fire-brick ; and if (as is generally the case) the brick-earth contains oxide of iron, the sand and alumina being in equal proportions, a most excellent brick may be produced ; but if the oxide of iron is in excess, the brick will be liable to fuse at a white heat. The quantity of sand contained in a certain quantity of brick-earth may be easily ascertained by washing away the clay in the same way that clay or washing stuff is puddled or washed on gold-fields. Although bricks containing sand in excess are easily burnt they are not fusible, nor can the particles be properly united without the addition of a flux, such as carbonate of lime in the shape of powdered chalk or limestone, or a larger proportion of oxide of iron than is generally found in brick-earth. Bricks made from pure clays not only shrink too much, but crack, and are rather *baked* than burnt ; such bricks are hard and tough, and will not bear cutting. Pure clay may be improved by the judicious mixture of sand, and still more so by mixing breeze, or fine cinders, or coal-dust in very small proportions if intended to be burnt in colonial clamps. This process is not followed in Victoria on account of the

extra expense; but it is probable that the refractory clays overlying bluestone might be rendered more serviceable as brick-earth were this system pursued. I have no doubt that good brick-earth is to be found in most parts of the colony; it is very common in the silurian or gold-producing formation, also in the granite and tertiary formations. Were the washed clays or sludges of the gold-fields mixed with the washed sand (deposited by the sludge) in proper proportions it is more than probable that excellent *cutters* might be produced, which might be easily sawn and rubbed to any required dimensions, and also gauged or bevel-bricks for arches. Beveled bricks for gauged arches are now made at Brunswick, the price being about four times that of the best colonial bricks. With the washed clays and sand of the gold-fields, which now form the sludge nuisance, thousands of excellent *cutters* might be made at about double the price of ordinary bricks which, although of no advantage to Melbourne until the railways are completed, would in the meantime be of great value to Sandhurst, Castlemaine, Ballaarat, and other townships on the gold-fields. The rich cream-color of the London *malm-cutters* is produced by the mixture of chalk; and I have no doubt that calcareous clay might be obtained contiguous to limestone formations, as at the Heads, Geelong, Limestone Creek, &c., from which good cream-colored bricks, if not *malm-cutters*, could be produced at a reasonable cost.

2. *Weathering*.—It is customary in England to expose the brick-earth to the action of the frost, but in Victoria the clay is no sooner obtained than it is tempered and moulded, often in the same day; but this rapid manipulation can only be pursued with mild clays. It is usual to dig pits, about 18 inches deep, into which the clay is thrown, watered and opened, and allowed to remain for a day or two before it is tempered; it is then taken to the pugmill, or tempered by hand.

Grinding.—Although this process has been but little, if at all, practised in Victoria, it is one which is absolutely required, to render some clay fit for bricks. Most excellent bricks have been made by Messrs. Cornish and Bruce, in the Black Forest, which seem to require only this process to place them among the best of colonial bricks. Whenever the brick-earth contains fragments of rock, or iron stone, it must be ground to render the mass homogeneous, and to prevent the bricks cracking, or flying while burning.

3. *Tempering.*—The object of tempering is to bring the brick-earth to a homogeneous mass, so as not only to be easily moulded, but also easily dried and burnt; the best brick-earth, if not properly tempered, will produce unsound bricks. The system generally pursued in Victoria is hand, or manual tempering. If a pugmill is used, a considerable saving will be effected after the first cost, which is often considerable. As the pugmill requires a steady continuous motion, no animal power is so well adapted as steam or other mechanical power. If a pair of bullocks are used, they require too much looking after, not only in the pugmill, but out of it. Two inferior horses would “eat their hearts off” if corn-fed, and one good horse, if strong enough, is too good to put into a pugmill, where he soon becomes fit for nothing else, even supposing he can stand the continuous collar work, which few horses can do. In brick machines, as in that of Clayton’s, the tempering and moulding are performed simultaneously; but unless a large quantity of bricks (say a million) are required, it will not pay for a steam engine, and, as before shown, animal power is not to be depended upon, and is, therefore, unsatisfactory. The brick moulding machines imported here have a die, or mould, much larger than the colonial size, but which may be altered for a few pounds to any size required.

4. *Moulding.*—The system of moulding generally pursued in Victoria partakes of both the systems known as *pallet* or sand moulding, and *slop* moulding. There is little difference in the cost of slop and sand moulding, for although a sand or pallet moulder will turn out three times the quantity of bricks in a given time, it is owing to his having the *clot* prepared for him, whereas in slop moulding the moulder prepares it himself; but in the system pursued in Victoria, although the mould is wetted, and the clot prepared by the moulder, as in slop moulding, the wet bricks are turned out on pallets and barrowed to the back ground, as in sand or pallet moulding. Although machines are occasionally used for moulding, yet the saving in the labor is so small, compared to the total cost, that except for large quantities of bricks, as before stated, there is little advantage to be derived over the more general system of hand moulding.

Dry-moulded Bricks are made from dry clay, which is reduced to powder, and afterwards pressed together by enormous pressure; they are then fit to handle, and may be stacked in the kiln, and

burnt forthwith, but they are generally inferior to the best samples of colonial patent wet-pressed bricks, the outside being generally harder than the inside, which is the last part of the brick to dry, and which, in drying, causes the outside to crack. The size of the brick-mould to produce a brick of a given size will depend upon the quality of the clay, pure clays shrinking more than mild clays.

Moulded and Angle Bricks.—Considering the great cost of moulded stonework, it is surprising that moulded bricks have not been more extensively made in Victoria, especially when such superior samples of white and cream colored colonial bricks are to be had (as may now be seen at the Building Museum) at about £7 per 1000.* Taking moulded headers at £1 per 100, delivered in Melbourne, I find, on referring to the *Victorian Contractors' and Builders' Price Book*, that the expense of moulded brickwork, as compared with moulded Bacchus Marsh stone, would not be more than one-third, or one-fourth of the cost of moulded Kangaroo stone, or one-sixth the cost of moulded bluestone. If moulded bricks are made larger than ordinary bricks, they are known as *terra cotta*, and must be perforated, so as to allow of their drying and burning without flying. If proper precaution is observed, the use of moulded bricks, and *terra cotta*, may be extended almost indefinitely, as in copings, cornices, strings, &c.; irregular-sided bricks are also in common use in England, and might be introduced here with advantage, such as radiated *stretchers* for well steining, made to radii of from four to six feet; splayed bricks for window jambs; bricks for octagonal chimney shafts, or walls, with one edge beveled to an angle of 135°, either of which kind of special bricks ought not to cost more than 30 per cent. more than the cost of common-shaped bricks of the same materials. Perforated bricks are made here, but I have seen none of equal quality to the best solid bricks; this may be owing to the inferiority of the clay of which they were composed, and not to the perforation.

5. *Drying.*—The principal point to be attended to in drying bricks is to protect them from the rain, wind, and sun, so that one side of the *backs* do not dry faster than the other side, or they will be twisted and cracked. To effect this desideratum recourse is had to screens or *lieus*, straw, swamp grass, sacks, calico, matting,

* This was in August, 1860.—C. M.

felt, and tarpaulins; but all these appliances are but sorry substitutes for drying sheds, which should always be erected where a large quantity of bricks are required, as the saving effected in the cost of attendance and losses in the destruction of *green* bricks by the first method is soon saved by the use of drying sheds. The difference in the time and trouble required to dry different kinds of clay is very great; clays containing too little sand, require at least double the time and attendance in drying as compared with bricks made from mild clay. If ashes or coal-dust are mixed with the bricks, they must be thoroughly dried to resist the too sudden application of the firing; this is not of so much importance when they are free from fuel, because the heat can be applied more gradually. The drying generally takes from a fortnight to a month. The best bricks are sometimes dressed with a beater, when half dry, to improve their shape by rectifying any warping or twisting that may have occurred during the first stage of drying; but this improvement is more effectually performed by a press, when they are called pressed, or patent-pressed bricks.

6. *Burning*.—In Victoria, bricks are generally burnt in *clamps*; they are loosely packed, so that the heat may spread between them. This is also the method adopted in kilns, which are merely permanent casings, the casing in the ordinary clamps being merely loose bricks, half a brick thick at bottom and brick on edge at top, or upper part of casing; this is always plastered over with clay, so as to make the best of a poor substitute for a kiln. *A kiln is most economical* where a permanent brick-field is established, on account of the great waste of fuel and bricks, often attending the use of *cased clamps*, the continuous action of the wind from the same quarter, driving the fire from the weather side of the *clamp*. This can be partially guarded against by putting up screens next the end of the fire-holes exposed to the wind. The clamp or kiln is at first but gently fired, until the steam from the bricks ceases to rise; the top of the kiln is then covered up with a layer of old bricks, upon which is spread loam or soil to keep in the heat, the fires are then gradually increased, until the bricks are brought to a white heat, which can be seen in the dark through the casings; but this period in the firing must be ascertained from trial holes, when it occurs in the day time, or in a kiln, and also by the time and fuel used. After the bricks have been brought to a white heat, the firing is as gradually

reduced as it was increased to attain this heat; the fire-holes are then bricked up and plastered over with clay, and the clamp or kiln is allowed gradually to cool, the cooling not being hastened by opening the *clamp* or kiln too soon, which would impair the soundness of the bricks. A temporary roof is generally erected over the clamp, to protect it from the rain, which would otherwise do as much injury as the uncontrolled action of the wind in the fire-holes. Clamp burning, as practised in Victoria, takes about one measured ton of colonial hardwood to each 1000 bricks, made from mild clay, the purer clays requiring much more fuel. The wood used should be dry, but may vary from the ordinary size of billets to logs that require two men to handle effectually.

Kiln-burning.—Although not practised in the colony, it is to be recommended for the reason before stated. The simplest form of kiln is the rectangular or clamp form, the walls of which may be made of any thickness, from one-third to one-tenth their height, the thick walls being less liable to crack than the thin ones, and therefore more easily and cheaply kept in repair, and occasion less waste of firing. Narrow-arched openings are left in the sides for fire-holes, and a narrow-arched doorway at each end, through which the bricks are passed for stacking and unloading the kiln. The kiln having been fitted, the doorways are bricked up and plastered, and the same regulation and process is followed as before mentioned for clamp-burning. A leanto shed is generally put up on each side of the kiln, to protect the fuel, fire-holes, and firemen from the weather. I have no authentic data as to the saving in wood-fuel, but it may be safely inferred that bricks, when kiln-burnt, would not take more than three-quarters of a ton (measurement) of dry wood to the 1000 bricks, thus effecting a saving of at least one-fourth in the quantity or weight of fuel by kiln-burning over that of clamp-burning. Neither system of clamp or kiln burning here mentioned is pursued when coal-dust or breeze is mixed with the clay before it is moulded; when this is the case, the bricks should be closely stacked in the clamp or kiln, with a thin layer of breeze or coal dust between each course, and barely sufficient firing used to ignite the bricks next the fire-holes, each brick forming a fireball in itself, because it contains its own firing. The fire is rapidly spread throughout the kiln, which, in London, takes from a fortnight to a month burning, but there clamps are ten times the size of those hitherto used in Victoria, from which I

should infer that clamps of less than 100,000 bricks might be burnt in a week. Coal dust is too expensive to pursue this system here, but it remains to be seen how far sawdust may be substituted to produce a light brick suitable for arches, vaults, and domes, in the place of the very dense heavy bricks now made here in great perfection. In 1858 (I learn from the Blue-book) there were 149 brick-fields in this colony. Bricks vary as much in price in Victoria as in England; ordinary bricks may be obtained from £3 to £4 per 1000, but the best quality, such as the patent pressed bricks, are at least £5 per 1000 at the kiln. English fire-bricks, although stated to be imported here at £6 5s. per 1000 in the former part of this article, are seldom sold at less than £8, the general retail price being about £9 per 1000. Bricks nearly equal in quality to imported fire-bricks are now made in the colony, and sold at from £5 to £6 per 1000. As the good quality of these bricks become more generally known, they will doubtless eventually entirely supersede the importation of even fire-bricks.*

BONE BLACK.

Bone black or animal charcoal, is made by calcining bones in similar retorts to those used in gas-works. In 1858 we exported bones to the value of £3067 †; in the manufacture of bone black whether for animal charcoal or for ivory black, such bones as cannot be used for, and the refuse from, boneware, can be calcined with advantage.

Animal charcoal is said to deprive solutions, particularly syrups, of their coloring matter more readily than vegetable charcoal; 10 per cent. more of refined sugar can, also, be obtained from the raw material with animal than with vegetable charcoal.

The bones lose about half their weight by calcination in retorts, and the charcoal is ground and sifted before it is used.

Sal-ammoniac.—The condensed vapors issuing from the retorts, after undergoing several manipulations, are converted into “sal-ammoniac,” or the muriate of ammonia of commerce. Since the general establishment of gas-works throughout England, “sal-

* See the article on Bricks and Tiles, in the Appendix.

† In 1859 we exported bones to the value of £5135—C. MAYES, June 28, 1861.

ammoniac," and other preparations of ammonia, are made from the ammoniacal liquor, distilled with tar, from the coal used for generating gas. "In a chemical factory near Glasgow, 720 gallons of ammoniacal liquor are rectified by distillation, to which 450 lbs. sulphuric acid is slowly added, the produce being 240 gallons of sulphate of ammonia, which is decomposed by common salt. In the distillation of the crude liquor, 90 gallons of tar is obtained by subsidence, and 20 gallons of petroleum is skimmed off the surface. The tar is converted, by moderate boiling, into pitch." (See "Ammonia" and "Gas.") Ammonia, in the form of "sal-ammoniac, is principally used for tinning cast iron, wrought iron, copper, galvanised iron, &c., and also in medical prescriptions."*

BRUSHWARE.

Brushware was imported to the amount of £21,745 in 1858.† For the manufacture of brushes we have bones, hardwood, and bristles, among our raw materials, which are the three principal articles required; we have also horsehair and dogs' hair, which are used for some kinds of brushes. It is probable that kangaroo hair and even camels' hair may eventually be used for this purpose in Victoria.

BUTTER.

In 1858 butter was imported to the amount of £308,000. Although this is a pastoral colony, very little butter is produced here. An ordinary cow will produce 1800 quarts of milk per annum, which will readily sell at 8d. per quart=£60; this quantity of milk will produce about 140 lbs. of butter, which at 2s. per lb.=£14, or less than one-fourth the sum produced by the raw material. These are also the proportionate prices of new milk and fresh butter generally maintained in Great Britain. We cannot, therefore, reasonably expect any great increase in the manufacture of colonial butter without a corresponding consumption of milk, which is not likely to take place without a proportionate increase in the population, unless in those instances where dairy farms are

* Dr. Ure.

† In 1859 we imported brushware to the value of £20,215.—C. MAYES, June 28, 1861.

established at too great a distance from any milk-walk, and yet at a convenient distance from a market for their butter. In such localities it would probably be found profitable to establish dairy farms expressly for the manufacture of butter; but as this subject may be considered to belong more to agriculture than to manufactures, I will leave it by merely stating, on the authority of Dr. Ure, that butter is soonest produced from cream when its temperature is from 53° to 57° . If dairymen when churning were to take the trouble to ascertain the temperature with a common thermometer they might often save themselves several hours' vexatious delay by attempting to churn when the cream is either below 50° or above 60° ; in this colony the latter will generally be the case.—See article on "Butter" in Appendix.

CANDLES.

No less than 1962 tons of candles were imported into Victoria in 1858, which were valued at £320,300; in the same year we exported 1016 tons of tallow, valued at about £44,000. We thus export tallow at about £43 per ton, and pay about £163 per ton for imported candles.* As I cannot tell the relative proportion of the different kinds imported, I cannot show what might be saved to the colony by the manufacture of any particular kind, but I will endeavor to show that no insuperable objection exists to the manufacture of the different kinds of candles now used in the colony.

Mould Candles.—On most stations and homesteads throughout the colony the common *mould* candles have been made, and are still made, simply because there is but little trouble attending their manufacture, and the material (ordinary house fat or tallow) is easily procured on the premises, and would otherwise probably be wasted or sold at about one-fourth of its value when made into candles. I have said there is but little trouble attending their manufacture, even in the very small scale attempted at stations and homesteads, where seldom more than two or three pounds are

* In 1859 we imported candles to the value of £215,796, and exported tallow to the value of £10,354, from which we may safely infer that the manufacture of candles in Victoria during 1859, greatly exceeded that of 1858.—C. MAYES, June 28, 1861.

made at one time by one set of moulds. It will be found that if made on a larger scale, as they might be by storing the fat or tallow for a few months, that the trouble would be materially reduced, and the candles might be made at the commencement and close of the winter in sufficient quantities for consumption during the year, instead of making small quantities, say monthly, in all weathers or temperatures, seasonable or unseasonable.

In 1858 there were thirteen candle manufactories in Victoria, three of which were in or near Melbourne. Both dip and mould candles are made here, but not *stearine* or any other superior or patent candles; these will probably be manufactured here in the course of a few years, as there is no great difficulty attending their manufacture, as I shall presently show. I have already referred to *home-made* mould candles, or mould candles made by amateurs at squatting and farm stations or homesteads. In making mould candles at candle-makers' establishments, eight or twelve moulds, according to size, are filled at one time, by being fixed in a frame like a stool; the tallow is supplied in a proper state for filling the moulds from an adjoining boiler, so that any number of frames may be filled as fast as the melted tallow can be drawn from the boiler. The time required to set the candles depends mainly on the temperature of the room in which they are moulded, but in cool weather about a quarter of an hour is sufficient. In England they have to be placed upon a table for inspection by the Excisemen; but in Victoria, they can be taken at once to the store, where, if kept for three or four months, they will become sufficiently whitened by age, and much better for use, than if used new after being bleached by exposure to the open air for a few days, which is sometimes done when a ready sale is desirable. Colonial mould candles have always obtained a good sale, as the number of candle manufactories will testify, notwithstanding the high price of labor, and this demand will increase as labor falls in value.†

Dip Candles are even more readily made than mould candles, and when we consider that only $1\frac{1}{2}$ per cent. in cost is all that is saved in obtaining a certain amount of light in the use of dip, as compared with mould candles (*See "Candles,"* by Dr. Ure), we

† In 1859 there were eighteen soap and candle manufactories in Victoria.—
C. MAYES.

must necessarily feel surprised that the slovenly, guttering, wasteful dip candles, made in the colony are tolerated. In Edinburgh a simple candle-dipping machine is in use by which one man can dip or make no less than 5000 candles in eight hours, in "moderately cold weather;" it necessarily follows that the item of labor, which in most manufactories is a considerable one, need scarcely be taken into account in making *dip* candles in cool weather.

Stearine Candles are made from saponified tallow or tallow converted into soap by an alkali, such as potash, soda, or lime, the last being generally used on account of its cheapness. The tallow and lime are boiled with water, and converted by this means into a kind of hard white soap, which is dissolved by oil of vitriol (sulphuric acid) when the stearic acid is brought to the surface as an oily substance; it is then drawn off, put into casks, and subjected to hydraulic pressure, which separates all impurities, leaving the stearic acid pure and white and fit for immediate conversion into candles; it is then cast in moulds the same as common candles, but the mould must be plunged into cold water to prevent crystallisation by too gradual cooling. This process, one would imagine, might be applied with advantage in cooling common mould candles in hot weather, the whole frame being lifted and plunged into a cold bath by means of a crane suitably fixed for the purpose. *Stearic acid*, or, as they are erroneously called, *stearine* candles can scarcely be distinguished from wax candles, which they are fast superseding. They are here known by the general name of patent candles, and are much sought after, 16d. per lb. being a common price charged for them, being at least double the price of common mould candles. The manufacture of soap and candles are often carried on together, since I perceive by the Melbourne Directory for 1860, that there are eight candle and soap makers in Melbourne and its environs. The only obstacles to the manufacture of *stearic acid* candles in Melbourne hitherto has been the high price of labor, and oil of vitriol, the latter of which would have to be imported for the purpose; the other two articles required we have in abundance, viz.; tallow and lime. There certainly seems to be a favorable opening for an enterprising soap and candle maker to enter upon this branch of the trade, which has hitherto, as far as I can ascertain, never been attempted in this colony.

CARRIAGES, CARTS.

Under these heads we find imports in 1858 to the value of £55,000,* which I imagine includes all American vehicles, and likewise coaches, omnibuses, railway carriages, &c. The manufacture of these articles are rapidly progressing throughout the colony, our colonial woods being well adapted for this purpose; those principally used consist of blue and red gum, box, ironbark, blackwood, apple-tree, &c.—the blue gum, box, and blackwood being the three most valuable kinds of wood for these purposes. Railway carriages have been made here at a cost of about 20 per cent. more than those imported; this is due not to their cost in England, but to the expenses of shipment, damage on the voyage (to which this class of highly-finished carriages are particularly liable) and to the fact of their parts having to be put together, repaired, and re-finished in this colony. The Legislative Assembly having pledged itself to the manufacture in the colony of any railway carriages required for the Victorian railways, it is likely this particular branch of the trade will not stand still for the want of protection. Even so far back as 1854, “The Hotham Gig,” made in the colony of native materials, by “Crothers and Hackett,” was exhibited at the Exhibition in Melbourne; at the same time, Mr. E. Chambers exhibited a colonial-made “wrought-iron skeleton for a railway wheel.” Since then every description of carriage, or vehicle, carts, wagons, and drays have been made not only equal to those imported, but, as a rule, far superior, and readily selling for at least one-half more: but this is owing more to the ignorance of the requirements of the colony than from any want of material or skill in England. Those elegant, light, and strong American buggies seem to be great favorites with the citizens of Melbourne, who naturally enough object to pay 40 or 50 per cent. more for a colonial substitute, the earnest cries of our coachbuilders for protection notwithstanding. On referring to the Melbourne Directory for 1860, I find no less than thirty-seven cart and wheel wrights in Melbourne and its neighborhood, and thirty-six coachbuilders. In 1858 there were also nine coachbuilders at Geelong.†

* In 1859 we imported carriages, carts, &c., to the value of £61,686, nearly two-thirds of which were from Boston and New York.—C. MAYES, June 28, 1861.

† In 1859 there were forty-eight coach factories in Victoria.

CEMENT AND LIME.

In 1858 we imported cement to the value of £11,200, at about 5s. per bushel. We also imported 3400 bushels of lime at the same price, and exported 12,000 bushels of lime at 1s. 10d. per bushel, here we have an anomaly requiring explanation; the common lime (as chalk lime) is sold in England at about 7d. per bushel, taking into consideration the difference in the price of labor, which is at least four times as great here as compared with England, lime of a good quality is cheap here, being only 1s. 6d. per bushel in Melbourne, or about two and a half times the price of ordinary lime in England; and from the facilities which exist in most parts of the colony for its manufacture, the price generally does not exceed this, the lime imported at 5s. per bushel must, therefore, be hydraulic lime. In treating of cement and lime it will be necessary to distinguish the two by showing the peculiarities of each. Common lime is produced by the calcination of carbonate of lime in the form of chalk, limestone, freestone (which is a pure limestone capable of being easily dressed or worked, and fit for building stone), and marble (a limestone sufficiently hard to be polished, and like chalk, consisting almost entirely of pure carbonate of lime). Lime made from these substances, and containing upwards of 95 per cent. of carbonate of lime, as the Heads lime for example, is only fit for building (in the form of mortar, plaster, or concrete), in situations not exposed to rain, and is not fit for drains, or culverts, cellars, tunnels, or hydraulic works—in fact, it can only be depended upon for durability when used in sheltered situations or for the inside of buildings. In all situations, continually or periodically exposed to the action of water, hydraulic lime must be used, which differs only from common lime in containing more than 5 per cent. of clay or alumina.

Hydraulic Lime and Cement.—A limestone containing 10 per cent. of alumina would make a good hydraulic lime; but an argillaceous limestone, containing 30 per cent. of alumina, would produce a strong hydraulic lime, which we should call cement. Portland and Roman cement are both strong hydraulic limes, and contain more than 30 per cent. of alumina, which causes them to set very readily; the time required for setting any kind of cement depends chiefly on the quantity of alumina it contains. Limestone is found in many parts of the colony; there is scarcely a county

in which it does not abound more or less. From the Blue-book I find there were ten limestone and 19 freestone quarries in Victoria in 1858,* which supplied 47 limekilns, 28 of which were in the county of Mornington, including the Heads, Western Port, and the S.E. coast of Hobson's Bay. The Geelong lime is slightly hydraulic, and that made on the Limestone Creek, between Mount Franklin and Guildford, is more so. There are doubtless other weak hydraulic limes made in the colony whose qualities have never been fairly tested, probably on account of their hydraulic properties being unsuspected by the proprietors. At the Melbourne University may be seen specimens of tertiary limestone obtained from at least nine different localities, many of which, judging from the appearance of the specimens would produce lime more or less hydraulic. Mr. Selwyn, our Government geologist, in his report of July, 1854, referring to the lowest bed in the tertiary formation on the eastern coast of Hobson's Bay, describes it as a "bed of stiff, blue clay, containing bands and septaria of hard, grey argillaceous limestone." Further on he says, "it is of excellent quality, and might be found highly valuable for making hydraulic cement. Calcareous nodules of a precisely similar nature are extensively collected for that purpose from the London clay, the cliffs of Hampshire, the Isle of Sheppey," &c.

Kilns.—Apart from the qualities of our limestones and cement stones, there is room for improvement in their calcination. There are two distinct kinds of kilns in use in England, viz., the "running" and the "flare" kiln. The "running" kiln is so called from the facilities it affords for running out the lime at the bottom, while the process of burning the chalk or limestone continues. This description of kiln is in the form of an inverted cone, and built where practicable on the side of a hill, the material and fuel being thrown into it in alternate layers. This is the kind of kiln generally used in this colony where wood is burnt instead of *breeze* or cinders, the common fuel used in England; but the "running" is considered inferior to the *flare* kiln in which the best kind of lime is always calcined; it is similar to the running kiln, but is

* As few people know the difference between freestone and sandstone, it is more than probable that the majority of the so-called freestone are really sandstone quarries, Victorian freestone being a very scarce article.—G. MATES, June 25, 1861.

domed over, leaving a small chimney on the top to allow the smoke to escape; the chalk or limestone is built over the furnace forming a rough arch on which the bulk of the limestone rests, and which is supplied through an arched entrance left in the side of the kiln for the purpose of filling and emptying it. When filled this entrance is blocked up, and the kiln is fired from below in the same way that brick kilns are fired. The firing is kept up for about two days when the body of the kiln attains a white heat; it is then allowed to cool, and the lime withdrawn. The cost of lime burnt in this way is not more than 15 per cent. in excess of the mode pursued here, viz., by the "running" kiln, whereas the lime is fully 20 per cent. more valuable, being free from *core* and well burnt.

The importance of obtaining good lime induced the Victorian Contractors and Builders' Association to form a company for the manufacture of lime, the members of this association taking the largest amount of shares. By their prospectus they calculated on being able to make lime superior to that hitherto manufactured in the colony at about two-thirds the current price. It will be seen on reference to the commencement of this article that we exported 12,000 bushels of common colonial lime in 1858; while we imported hydraulic lime and cement to the value of nearly £20,000.

Artificial Cement.—If we have not sufficient natural cement stones to supply our wants we can at least make an artificial cement fully equal to any we import. All that is required is to mix ground limestone and clay in the proportion of 6 of the former to 1 or 2 of the latter, according to the quality of the cement or hydraulic lime required. This mixture, which should be well incorporated in a pugmill, may be either moulded by the same machine into cakes or bricks, and dried in *hacks*; or the mixture may be merely spread out into thin layers, dried, and broken up into fragments. There is less waste in the former method; and if the machine both tempers and moulds the cakes it is the best and cheapest. These artificial cement stones or cakes may be burnt in either a common *running* or *perpetual* kiln, or in a *flare* kiln, the latter being the best, as before stated, for lime.

Fuel for Kilns—The quantity of wood required either for lime or cement kilns is about two cubic feet of wood to every bushel of lime or cement, which is equal to 200 cubic feet measured in the heap or *bolt* for every hundred bushels of lime. The manufacture

of cement in this colony is of more immediate importance than the manufacture of lime; we already produce more common lime than we require, seeing that we exported 12,000 bushels in 1858.

It is more than probable that this colony contains large quantities of cement stones or argillaceous limestone in beds or nodules fit for cement. In limestone localities are also found calcareous clays, which only require drying and burning to produce cement. "M. de Breislak thinks that it is to the happy union of *travertino* and *puozzolano* in the same spot that the monuments of Rome owe their great solidity." The manufacture of cheap cement, combined with the facilities of its transport throughout Great Britain, has almost superseded the use of *trass* and *puozzolano*, which used to be largely imported into England from Italy and other volcanic regions, to be mixed with lime and sand for hydraulic mortar.

This colony abounds with *travertino*, or a good substitute for it, in the recent limestone deposited by desiccated lakes or ancient streams, and also with *puozzolano*, or a substitute for it, in the calcined earth covering our basaltic plains; but as to whether the monuments of Melbourne 1000 years hence will owe their great solidity to this circumstance will depend not only on the wisdom of our engineers and architects, but also upon the enterprise of our colonial manufacturers. It is a well-known fact that imported cement is often more or less injured by a long sea voyage. There are also both public and private works erected in localities where cement would be too costly to be largely used if imported. In such localities it may sometimes happen that the very earth excavated from the site of the work for the basement or foundations of the building may consist of marl or argillaceous limestone, which might be burnt into cement on the spot, or such material might be obtained if properly sought for within a reasonable distance.

M. Vicat, the celebrated French engineer, during his lifetime saved to the French nation £7,000,000 in the manufacture of cement for their public works. When first employed by the French Government there were only seven or eight cement quarries in France; at his death there were between 700 and 800, and chiefly through his exertions in this direction France has become celebrated for her great hydraulic engineering works.*

Uses of Lime.—In addition to the use of lime for building pur-

* Civil Engineers and Architects' Journal, vol. 9, p. 35.

poses, it is largely used in agriculture, not only in its pure state as a manure, but also as a deodoriser of night-soil, by which means one of the most valuable manures is obtained; it is also used in sugar-works, gas-works, soap and candle works; in bleaching linen and cotton, in fellmongeries and tanneries, in medicine, and in chemical researches.

Cement is used not only for building purposes but in the manufacture of *beton*, or hydraulic concrete, for vases, fountains, &c., as an artificial stone. See Article on "Cement," in Appendix.

CHARCOAL.

The uses to which charcoal is applied are numerous; those kinds containing silica are used for polishing metals; it is a bad conductor of heat, and is sometimes used to encase steam-pipes, and small furnaces. It is a most useful deodoriser for removing offensive smells from animal and vegetable substances, spirits distilled from bad grain, &c. (of which we have hundreds of thousands of gallons in bond—see "Brandy," page 32); in the construction of filters, both portable and upon a large scale, as for reservoirs, for which latter purpose it might be applied for filtering the impure water of the Yan Yean reservoir.* It is also used in the manufacture of the most durable ink, or black pigment. The ancients wrote with ink made from ground charcoal; and the writings found in the ruins of Herculaneum, more than 2000 years old, have retained their original blackness. Many other instances might be given of the indestructibility of charcoal, not only in ink or pigments, but also in the charred ends of stakes and piles.

Metallurgy.—By far the most useful and most extensive use to which charcoal ever has been applied is as a fuel in metallurgy. It has been used for smelting, or the reduction of iron ores, from the earliest records. Until the year 1740 it was the only fuel used in England for this purpose, and it was not until the dawn of the present century that coke and coal came into general use in England, not on account of their superiority to charcoal for the reduction of the iron ores, but more on account of the scarcity of wood in England, and the abundance and economy of coal: even now charcoal is used in England for the manufacture of some kinds of iron, and more especially in the conversion of charcoal

* This was written in July, 1860.—C. MAYES, June 26, 1861.

iron into steel, for which it is universally admitted to be superior to any other fuel.

Swedish Iron.—Swedish (which generally sells for about three times the price of English) iron, is always smelted with charcoal; it is also used for this purpose in France, and on the continent of Europe and Asia, the iron of Hindostan being similar to Swedish iron. Charcoal is superior to coke or coal for smelting iron because it contains no sulphur; the fumes of sulphur have a most injurious effect upon the iron it impregnates, and unless effectually eradicated, which is not always practicable, will cause latent flaws in castings; cast iron girders for breastsummers and bridges have been known to give way solely on that account; it is therefore very important that such iron should be fully tested before being used, and this is now usually done.

Tin Ores.—Charcoal is also generally used in the reduction of tin ores, and the manufacture of tin. As both iron ores and stream tin are among our raw materials, it is probable that charcoal will be extensively used in the manufacture of these metals, and more particularly in those localities where coal would be almost inaccessible, and charcoal plentiful and cheap.

Victorian Charcoal.—Neumann, who made many experiments on charcoal, informs us, that “for the reduction of the metallic oxides the charcoal of the *heavier woods* is preferable, and that for common fuel such charcoal gives the greatest heat.” With a trifling exception, the whole of the timber of Victoria is both *hard* and *heavy wood*, generally heavier than water before it is dried and seasoned; in this respect at least we have an advantage.

The quantity of charcoal produced from different kinds of wood varies from 15 to 20 per cent.; the heavy woods do not always produce the largest quantity *but the best*. Charcoal like lime gains weight by exposure to the air. Messrs. Allen and Pepys found that by a week's exposure to the air the charcoal of six different kinds of wood they tried gained from 10 to 18 per cent. in weight.*

The facilities for the manufacture of charcoal in Victoria, where any quantity of wood can be obtained from the Crown lands on payment of a trifling license fee per annum, are only to be known to be acted upon. The charcoal hitherto supplied to founders,

* Dr. Ure.

plumbers, tinsmiths, &c., in Melbourne, is manufactured in a very imperfect manner from wood felled expressly for it, and burnt on a small scale, the pyroligneous acid, tar, &c., being wasted, the majority of the charcoal burners being unaware of its existence in all kinds of hard wood; they sell the charcoal in Melbourne at about 1s. 6d. per bushel, being equal to about one penny per pound, or wholesale, say £6 per ton.

Pyroligneous Acid.—If the manufacture of charcoal alone will pay, how much better return would it make were the pyroligneous acid, or wood vinegar, collected and sold to manufacturing chemists for re-distillation, &c., into acetic acid; it could even be re-distilled by the charcoal burner for wood-vinegar, since the process is simple and comparatively inexpensive.

Produce of Waste Timber.—The manufacture of these commodities in connection with the supply of sleepers for our railways, or with saw-mills, from the waste wood hitherto considered useless, is obvious.

I will endeavor, from a few calculations based upon well-established facts, to show the profits likely to arise from the production of sleepers, posts, and rails, or sawn hardwood of all kinds in conjunction with the manufacture of wood-vinegar, or acetic acid, and charcoal from the waste timber which would otherwise be left as useless, except in those few cases where it could be sold as firewood.

For the railway now being constructed between Melbourne and Sandhurst we require 3520 sleepers per mile, *i.e.* one per lineal yard for each line of rails, and for 100 miles (the distance between Melbourne and Sandhurst) no less than 352,000 hardwood sleepers will be required; each sleeper contains about four cubic feet, giving a total of 1,408,000 cubic feet of timber required for this railway in the form of sleepers for the permanent way. Our hardwood when about half seasoned would weigh about 56 lbs. per cubic foot, or 40 cubic feet per ton. In falling timber for sleepers, or for squared timber generally, at least one-third is wasted; this waste timber consists of the refuse from the trunk and the whole of the top of the tree: now 704,000 cubic feet at 40 feet per ton is equal to 17,600 tons. I have before shown that hardwoods produce from 15 to 20 per cent. of their weight in charcoal, and that they gain about 15 per cent. in weight by the absorption of moisture from the air during one week's

exposure; hence we may safely take the produce of charcoal from our hardwoods at 25 per cent., or one-fourth, therefore 17,600 tons of hardwood would be likely to produce about 4400 tons of charcoal, which, at £3 per ton (about half the price in Melbourne), would be worth £13,200. The best charcoal and the largest quantity of pyroligneous acid is produced from the *greenest* timber, or timber not long felled; all the small boughs and leaves will be consumed in firing the charcoal, which may be burnt in heaps or in kilns, the latter mode producing the largest quantity of liquid products. Stoltze has ascertained by numerous experiments that one pound of wood yields from six to seven and a half ounces of liquid products; hard timber which has grown slowly upon a dry soil gives the strongest vinegar. Charcoal burnt in a kiln, with a pipe to condense the vapors or fumes into a tank, yields about 25 per cent. of the weight of wood in liquid products, or crudo wood vinegar.*

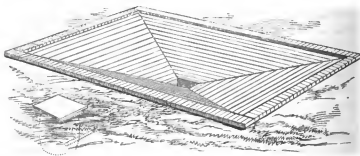
Clearing Land.—Another facility for the manufacture of charcoal is presented in clearing land for agricultural purposes, &c., and, in doing so, the timber has not only to be felled, but also to be sawn into portable logs, which are heaped together—for what?—not to be burnt into charcoal, worth at least £3 per ton, as fuel for foundries, &c., or to be used as a deodoriser when mixed with double its weight of night-soil, forming a most valuable and powerful manure; but to be consumed and cast to the winds, yielding comparatively little, in the form of potash, for the trouble of clearing and burning; whereas, by a slight increase in the expense required in splitting the largest logs, stacking them, and covering up the heaps with clay, sods, or the surface soil, they might be burnt into charcoal; should the land be heavy, clayey, or strong land, requiring burnt clay for manure, the advantage would be still greater, since the surface of it might be burnt by merely covering up the stacked heaps of wood to be converted into charcoal. Thousands of tons of hardwood have been destroyed in this way, merely to clear the land for agricultural purposes. To show that I have not over-estimated the value of charcoal as a fuel, I will merely state, on the authority of Dr. Ure, that one pound of wood charcoal will raise 73lbs., of coke, 65lbs., and of pitcoal, 60lbs. of water from 32° to 212°. The relative heating properties of the most com-

* Dr. Ure.

mon fuels stand thus:—Perfectly dry wood, 35; wood in its ordinary state, 26; wood charcoal, 73; pitcoal, 60; coke, 65; turf, 30; turf charcoal, 64. In other words, for foundries, smithies, fuel for boilers, or the reduction of metallic ores, good hardwood charcoal will produce about 22 per cent. more heat than pitcoal, and about 12 per cent. more than coke by weight.

The price paid for the coke consumed on those portions of our Victorian railways now open for traffic cannot be far short of £7 per ton. Coals are now to be procured on the wharf in Melbourne at about £2 per ton wholesale. If consumed 100 miles inland, at least £5, or 1s. per ton per mile, must be added, making the total cost at Sandhurst, for instance, equal to £7 per ton.*

When it is considered desirable to save the liquid products of wood for the manufacture of acetic acid, wood tar, or creosote, in the absence of a kiln, earthenware pipes of 2 or 3 inches diameter may be inserted in the covering of the heap, and led into tanks, or small watertight vessels with moveable lids, which, with the joints of the pipes, must be luted with clay; the steam rising from the wood will pass through the tanks, being condensed in its passage. In addition to this contrivance, where a large quantity



of wood can be brought to one spot, it will be advisable to construct the heaps for burning upon a hopper-shaped hole, made in the ground and paved with bricks. "Into this space the tarry acid will partially fall, and may be conducted outwards by a small earthenware pipe into a covered brick tank," (or a cask, let into the ground, will answer the purpose equally well). A slab of

* This was written in August, 1860.—C. MAYES, June 26, 1861.

stone is placed over the tank or cask and an iron plate over the bottom of the hopper, to prevent the ashes getting into the earthenware pipe;* the whole will be best understood by reference to the annexed sketch, which represents everything required below the surface of the ground.

CREOSOTE.

See Pyroligneous Acid, under article Gas.

CORDAGE

In 1858, we imported cordage to the value of £61,782, and twine to the amount of £12,892, together exceeding £74,000.† As cordage is produced chiefly by machinery, we may soon hope to manufacture it in Victoria. On referring to the article on Paper, in this essay, you will find that flax has been successfully cultivated on the Experimental Farm, near Melbourne, "and the fact that it will thrive well in this colony has been fully established." On reference to the Blue-book for 1858, I learn that, in 1858, four acres of flax was grown in the county of Grant.

Native flax is found in New Zealand in great abundance; it is the produce of the plant *Phormium tenax*, and the Government of New Zealand has offered premiums for its successful manufacture into a merchantable commodity. The *New Zealander*, of May 30th, 1860, stated that, "as far as they were aware, no claimant had hitherto demanded the premium;" but that Baron de Thierry has invented a process, by which the native material can be manufactured into an article equal to the celebrated and valuable article of export, "Riga flax."

In answer to an extract from the above article in the *New Zealander*, which was copied into the *Argus*, a letter appears from Mr. H. Christian, of Kew, to the effect "that he had already manufactured 16,000 halters in this colony chiefly from New Zealand flax, and that there was no more difficulty in making New Zealand flax a marketable commodity than there was in threshing a sheaf of wheat." As Mr. Christian states he has had 40 years' experience in the working of hemp and flax, his statement as to the value of the article should be considered conclusive.

* Dr Ure.

† In 1859 we imported cordage to the value of £59,246, and twine to the value of £8914.

GAS.

With one exception (which I shall hereafter refer to), gas has been manufactured in our Victorian gas works from imported coal, our own coal fields being, as it were, inaccessible, partly from the want of railways, and partly from the great expense of working them.

The Melbourne Gas and Coke Company was established in 1850, and in 1859, no less than 50 miles of main pipes were laid, supplying about 45 millions cubic feet of gas per annum; since then 40 miles of mains have been received, for the purpose of supplying Richmond, Prahran, St. Kilda, Emerald Hill, Sandridge, and North Melbourne: so that we may calculate that in 1861, at least 70 millions cubic feet will be consumed in Melbourne and its environs. In 1859, the price of the gas supplied to the public was 22s. 6d. per 1000 feet; it has since been reduced to 17s. 6d. per 1000 feet.*

In January, 1859, the Collingwood Gas Company issued a prospectus, wherein they stated that "it had been satisfactorily ascertained, from careful estimates of gas engineers, and from the *experience of colonial establishments*, that gas of high illuminating power can be manufactured from British and New South Wales coals at a cost of about ten shillings per 1000 cubic feet, inclusive of interest on capital;" and also that "it is anticipated that the company will be enabled to supply gas of pure quality at a price for the first year not exceeding fifteen shillings per 1000 cubic feet, and subsequently at a lower rate." These gas works are expected to be in operation towards the close of the present year (1860), and from the small outlay of capital, as compared with the Melbourne Gas Works, are likely to become a profitable undertaking, even at 15s. per 1000 cubic feet.†

The Ballarat Gas Works yield about 300,000 cubic feet of gas per annum. There are also gas works at Geelong, Castlemaine

* By posting bills in Melbourne I find that the Melbourne Gas and Coke Company intend making a further general reduction to fifteen shillings per 1000 cubic feet, including the use of meters, after the 1st of July next.—C. MAYES, June 28, 1861.

† These gas works are now in full operation, and are producing gas at the rate of about 60,000 cubic feet per week, but will shortly be able to produce at least three times this quantity.—C. MAYES, June 2^d, 1861.

and Sandhurst, the gas being in each instance manufactured from imported coals. It is, therefore, not unlikely that, during the year 1861, no less than 90 millions cubic feet of gas will be consumed in Victoria, requiring about 10,000 tons of coal, from which about 6000 tons of coke, 1000 tons of ammoniacal liquor, and about 830 tons of tar may be produced. Hitherto, but little profit has accrued from these products to our Victorian gas works; they are valuable, and should, therefore, not be wasted, or unprofitably disposed of.* I will endeavor to show to what use they may be applied.

Coke is generally used for heating the retorts, about half the produce being consumed in this way, but as the coke is worth nearly as much per ton as coal, it is desirable to ascertain the practicability of heating the retorts with firewood. It would require about two and a half tons of ordinary firewood to produce heat equal in amount to that produced from one ton of coke. In many of our inland towns it may happen that coke would be worth from five to ten times its weight in firewood, and in such cases it would be most profitable to use the latter. In England coke is of sufficient value to render it profitable to make it from coal in coke ovens, in which all its volatile products are consumed. In Victoria it is not less valuable for locomotive engines, judging from its imported price, which is about £6 per ton.

In 1858 coke and fuel were imported to the value of £12,800; by fuel I imagine patent fuel is meant to be understood, the value of which is small compared with the coke. In the first six months of 1860 no less than 2150 tons of coke were imported, valued at £14,262, being about £6 12s. per ton; and 34,000 tons of coals, valued at about £1 16s. per ton. From which I am led to believe that coking, or the manufacture of coke from coal, in proper coke ovens, whereby the coals lose only 20 or 25 per cent. in weight, (without regard to its volatile products,) would pay well in Melbourne.

* The Melbourne Gas and Coke Company in May last, advertised for tenders for the purchase of the tar manufactured at their Gas Works during three or five years, (at the option of the tenderers,) from the 30th inst. On the 19th inst. there was an advertisement in the *Argus* for a foreman of chemical works, acquainted with the manufacture of the products of tar and patent fuel.—C. MAYES, June 29, 1861.

Tar.—The next product to be considered in the distillation of coals is tar, and, as before mentioned, we may reasonably expect about 830 tons to be produced in 1861, which, at £10 per ton, would be worth £8300. Should we find little or no demand for coal tar it can be converted into oil and pitch, 830 tons of tar producing about 210 tons of oil, and about 400 tons of pitch. The patent kerosene oil now coming into general use in Melbourne, and its environs, is nothing more than distilled coal oil, which is sold at 8s. per gallon retail; reckoning the wholesale price at 6s. per gallon 210 tons of coal oil would be worth about £13,000; the pitch would be worth about £15 per ton, or £6000, which, with the coal oil, amounts to £19,000, being an increase on the value of the coal tar of £10,700, or nearly 60 per cent. for expenses of distillation, a considerable, if not the major portion of which £10,700 must be clear profit, over and above the original value of the tar.* Should there be no demand at a remunerative price for either coal tar, coal oil, or pitch, the coal tar may be converted into gas, as shewn under *Olefiant gas* (which see); it will yield about three times as much gas as can be produced from an equal weight of coals similar to those from which it was obtained, and should, therefore, be worth at least three times the price of the coals per ton.

Ammoniacal Liquor, which is deposited with the tar in the tar tank, is most valuable as a liquid manure, and when diluted with four times its bulk of water becomes an invaluable top-dressing for grass lands, and for all other purposes to which guano and liquid manure are applied. Or it may be sold to the manufacturing chemists, who obtain about fourteen ounces of sulphate of ammonia from every gallon of liquor, and consequently from the 1000 tons before referred to about 110 tons of sulphate of ammonia may be obtained by saturating the solution with oil of vitriol, and

* These remarks apply more to a substitute for kerosene, sold as paraffine oil in Melbourne. The imported kerosene is either distilled from coal or from the petroleum or rock oil, which is obtained in great abundance from wells sunk for the purpose, on Oil Creek, a branch of the Alleghany River, in Erie County, Pennsylvania; at Tidionte, in Warren County, further up the Alleghany; the eastern part of the State of Ohio; and from a large territory on the Thames River, in Canada West; the last locality yielding a supply almost fabulous. See "American Rock Oil," (from the *Times*,) in the *Argus* of the 28th of May last.—C. MAYES, June 29, 1861.

evaporating to dryness; in the same manner we may obtain sal ammoniac or muriate of ammonia by using muriatic instead of sulphuric acid. Carbonate, or sesqui-carbonate of ammonia is generally prepared by subliming in a retort a mixture of one and a half parts of clean dry chalk, and one part of sal ammoniac; it is used in medicine, and by confectioners, to give sponginess to their cakes by its volatilization from the dough in the oven. Many patents have been taken out for manufacturing the different salts of ammonia from the ammoniacal liquor obtained from gas-works, among which that of Mr. Crolls stands pre-eminent, for purifying gas from ammonia (before it enters the lime purifier); this is effected by passing it through diluted sulphuric acid; this ingenious and valuable process not only purifies the gas, which would otherwise destroy the pipes, gas-fittings, gilding and metallic surfaces of ornamental apartments, but also yields a valuable product in the form of five pounds of sulphate of ammonia, which may be obtained from every gallon of the saturated solution of diluted sulphuric acid.* Its adoption is now becoming general in most gas works.

Coal Oil.—Dr. Ure states that “the coal oil, when rectified by distillation, is extensively employed for dissolving caoutchouc in making the varnish of waterproof cloth, and also for burning in a peculiar kind of lamp under the name of naphtha.” It is sometimes used to advantage in *naphthalising* poor gas, by which the density and consequent brilliancy of the gas is increased; this is effected by merely passing the gas through the distilled coal oil before it enters the gasholder.

Cyanide of Ammonia is likewise obtained from the ammoniacal liquor, which may be converted into Prussian blue by saturation with muriatic or hydrochloric acid, and then adding sulphate of iron. According to M. Jacquemyns, the quantity of cyanogen and cyanates contained in twenty gallons of ammoniacal liquor is sufficient to form one ounce troy of Prussian blue. Cyanide of potassium and prussiate of potash are also obtained from the cyanates, but in such small quantities that it is doubtful, in the present state of the colony, whether they are of sufficient importance to engage the attention of manufacturing chemists.

Bitumen.—The value of coals for the manufacture of gas

* Dr. Ure.

depends upon the quantity of bitumen they contain, cannel coal being the best. Mr. N. W. Pollard, of the Railway Department, has obtained a patent in this colony for the manufacture of gas from Trinidad and other bitumens, and applying the residuum products to the manufacture of black varnish, or japan, and tar; the patentee informs me that Trinidad bitumen can be imported here, by the cargo, at about £6 per ton, and that from experiments he made at gas works in New York in 1851, he obtained no less than 27,000 cubic feet of gas from a ton of bitumen.

Olefiant Gas is more easily manufactured, and produces a more brilliant light than coal gas. It has been superseded by coal gas in Great Britain on account of the low price of coals and the high price of oils and fats as compared with their relative value in Victoria. Oil or liquid fat produces about 15 cubic feet of gas per lb., while cannel coal produces only 4, and ordinary coal from 2 to 3 cubic feet per lb.; olefiant gas, from its greater density, is worth at least twice as much per 1000 cubic feet as ordinary gas from inferior coal; the value of oil, fat, or tallow, when used for gas will consequently be about ten times the value of such coals per ton, and where the cartage exceeds £3 or the cost of the inferior coals delivered at the gas works exceeds £5 per ton, it will be found cheaper to use oil, liquid fat, or tallow, where either of them can be procured at about £40 per ton, which is likely to be above the cost in many parts of the colony, since the tallow exported in 1858 was valued at only £43, including the cartage from the bush.* The blubber and sediment of whale oil may be employed with advantage in the absence of good coal; this may occur in the neighborhood of whale fisheries, as at Portland and Twofold Bay. Two patents have been obtained in this colony for the manufacture of gas from oils and fatty substances, one of them by a Mr. John Hart, in December, 1858, who also lays claim to certain improvements in the construction and shape of the retorts used: the other patent was obtained by a Mr. J. T. Sanders, who claims the manufacture of gas from oil of resin, and other oils and fatty substances, the gas being purified in the retort before it passes into the condenser, and lastly in the general management of the necessary apparatus. "In England, the relative

* In 1859 the tallow exported from Victoria was valued at about £42 per ton.—C. MATES, June 29, 1861.

cost of coal gas and oil gas may be estimated as one to six at least," as stated by Dr. Ure, who also adds, "Resin gas is cheaper than oil gas." The exceptions to this rule likely to arise in Victoria will be owing to the great cost of carriage; the coals in Melbourne being only £2 per ton, it follows that where coals cost £5 per ton in our inland towns, three-fifths of the cost will be for carriage; this is not the case with cannel coal, since it is worth about double the amount of ordinary coal, not only on account of its yielding a larger amount of gas, but also on account of the greater density and superior illuminating power of the gas obtained; therefore where cannel coal can be had for £10 per ton it will not be cheaper to make olefiant gas from tallow or waste fat even at £40 per ton.

Resin Gas.—The wholesale price of resin is about £12 per ton in Melbourne; and resin, according to Dr. Ure, will produce the same quantity of gas as can be produced from pitch, that is, about 10 cubic feet per lb., and will probably be found as valuable as coal-tar in producing an equal amount of light per ton; both resin and coal-tar may be considered to be worth about twice as much per ton as cannel coal so far as their gas-producing qualities are concerned: it follows, therefore, that at 120 miles from Melbourne, reckoning the carriage at one shilling per ton per mile, the cost of two tons of cannel coal at £3 per ton would be equal to the cost of one ton of resin or coal tar; therefore, if these materials have to be carted a greater distance than 120 miles, the two latter (*cæteris paribus*) will be the cheapest.

Portable Gas Apparatus.—Since writing the foregoing remarks upon the comparative cost of gas made from resin, tar, and coal, I have met with a pamphlet published by the Maryland Gas Company, of Baltimore, United States. This company manufactures portable gas apparatus for converting resin oil into olefiant gas; the apparatus is very simple and easily worked, and costs in Baltimore from about £70 for a complete apparatus, the gasholder of which contains 300 cubic feet, to about £200 for an apparatus with three retorts and a gasholder containing 1000 cubic feet; this apparatus is suitable for dwellings, churches, hotels, foundries, manufactories, &c. Other apparatus with four or more retorts and gasholders of any required size can be either made to order and imported from Baltimore or constructed in this colony under the sanction of the Victorian patentee before referred to, Mr. J. T.

Sanders. Mr. Ricards, sen., of the firm of Fisher, Ricards, and Co., of Melbourne, has a complete apparatus imported from Baltimore, which was temporarily erected between Spring street and the Parliament grounds about two years ago. He found it would not answer; that is, the gas would cost more in Melbourne than coal gas; this is also the case with gas made from tar, pitch, or oil, as I have before shown. The information contained in the above pamphlet is confirmed by some of the leading citizens of Maryland who have used the portable apparatus, and testify as to its superiority both in brilliancy and economy to either coal gas or oil lamps. From this pamphlet I also glean the following: "That a gallon of the resin oil will make from 75 to 100 cubic feet of gas of about twice the value in brilliancy as compared with common coal gas;" and, therefore, worth about 50 per cent. more than an equal quantity of cannel coal gas, from which I deduce the following estimate showing the comparative cost of cannel coal gas and resin oil gas, where the cartage of the material from Melbourne for producing the gas costs £4 per ton.

Resin Oil in Melbourne costs £19 per ton, and cartage £4 = £23 per ton, reckoning 80 cubic feet of gas per gallon: this is equal to about 20,000 cubic feet per ton, equal in light produced to 30,000 cubic feet of cannel coal gas. Against this we have cannel coal producing 10,000 cubic feet of gas per ton, which will require 3 tons for 30,000 cubic feet; cost of coal in Melbourne £12, and carriage £12 = £24, showing a saving of £1 in favor of resin oil gas; I therefore conclude it is cheaper to use resin oil in any locality in Victoria where the cost of carriage is more than £4 per ton from Melbourne. The original outlay for the manufacture of resin oil gas would not in any case exceed one-half the cost of outlay for ordinary gas works, on account of the greater simplicity of the apparatus and the saving in main pipes, since several portable gas works could be maintained without materially increasing the comparative outlay. Against this, and in favor of coal gas works, we have the liquid products and one-half the coke, the other half being required for heating the retorts. Fuel is also required in heating the retorts in the resin-oil apparatus, but as only a low heat is necessary it can easily be maintained with firewood; and against this slight addition to the cost, as compared with coal gas, we may fairly set the great saving in attendance and the cost of purifying resin oil

gas, which is actually purer on leaving the retort than the coal gas of Victoria after passing through lime purifiers, no other means having, up to the present time, been adopted to free our coal gas from ammonia, although (as mentioned under the head of *Ammoniacal Liquor* in this Article) Croll's patent apparatus, which is most efficient for this purpose, has been successfully used in England for many years; the destructive effects of ammonia, and the consequent necessity for its removal from coal gas, I have before referred to.

Gas from Leaves, &c.—In October, 1857, Mr. G. W. Praagst obtained a patent in this colony "for obtaining, by distillation from the several varieties of gum leaves—first, a spirito oleaginous compound or crude oil; and secondly, carburetted hydrogen gas, pyroligneous acid and tar."

That portion of the patent relating to the distillation of carburetted hydrogen gas from gum leaves, was successfully carried into effect in the gas works of Kyneton, this township having been lighted with such gas for about two years.* From the information I have been able to obtain, it is superior in illuminating properties to the gas obtained from the Australian hardwoods, but inferior in this respect to the coal gas made in Melbourne, which is produced from a mixture of common with from 5 to 10 per cent. of cannel coal. The quantity obtained from a ton of gum leaves is from 9000 to 10,000 cubic feet, whereas, wood produces only from 4000 to 6000 cubic feet of gas per ton, and even this small quantity is poor in quality, consisting chiefly of hydrogen gas. It will not, therefore, of itself produce gas fit for ordinary uses, but might successfully be used in combination with olefiant gas, gas obtained from resin oil, or with cannel coal gas.

Gas from Wood and Coal.—In December, 1857, Mr. J. A. Huxtable obtained a patent in Victoria for the manufacture of gas from wood and coal. He claims the invention of the manufacture of illuminative gas by the "distillation of peat or wood con-

* I have since ascertained that the patentee was compelled to resort to the use of cannel coal at the Kyneton Gas Works, to bring the gum-leaf gas to the required standard; and ultimately, on account of the difficulty of obtaining gum-leaves, the gas was made wholly from cannel coal.—C. MATES, June 29, 1861.

jointly with cannel coal, bituminous schist, or shale,* and natural bitumen."

This patent might be successfully carried out in supplying our inland towns with gas, the bitumen or natural asphalt (before referred to) being carted from Melbourne, and the wood found in the locality, used either in the same retort or in different retorts, the gas from each in equal volumes mixing in the gas-holder, by which an average quality of gas might be obtained for probably 25 per cent. less than gas wholly from fat, resin oil, cannel coal, or bitumen.

Gas and Pyroligneous Acid.—There is an advantage attending the manufacture of gas from wood, if the crude vinegar can be collected and distilled into wood vinegar, or pyroligneous acid, which may easily be effected, and would prove more profitable than the distillation of wood for its charcoal and liquid products only. This will be better understood when we consider that wood is distilled in clay retorts for its produce in charcoal and wood vinegar, in the same manner that coal is distilled for gas, coke, tar, and ammoniacal liquor in our gas works; the chief difference consists in the larger size of the clay retorts, used for distilling woods. "In an establishment at Glasgow the retorts hold 8 cwt. of hardwood each—oak, ash, birch, and beech, being used. The heat of the retorts is kept up during the day, and the furnace is allowed to cool at night; the charcoal is then removed, and a new charge of wood introduced. The average product of crude vinegar or pyroligneous acid from the 8 cwt. of hardwood is 35 gallons, which is contaminated with tar; the charcoal left in the retort weighs about one-fifth of the wood used;† hence nearly half the weight of the wood is lost in incondensable gas, which might be purified in its way to a gasholder, there to be mixed with richer gas.

* A paper was read by Dr. Ralph, at the Royal Society of Victoria, on the 27th May last, upon a mineral called dysodile, from Tasmania, when it was shown to be a bituminous schist or shale, containing a large amount of microscopical algæ, coated with a resinous substance. Dr. Crook stated that a company had been already formed in Tasmania to extract the oil from the substance, and that the mineral was distilled in common iron retorts, and was likely to become an article of great commercial value.—*C. MATEs*, June 29, 1861. *

† Dr. Ure.

Pyroligneous acid is used in the arts for such purposes that it need not be highly purified. The quantity of sap or crude pyroligneous acid in red gum and other eucalyptii must be very great, since these hardwoods lose about one-third of their weight in seasoning. This acid in different woods also varies considerably in strength or acidity; that contained in red gum must be very strong, because if a saw is laid upon a fresh sawcut, it soon turns the saw black, showing the presence of a powerful acid on the surface.

Creosote and the real paraffine is obtained from the wood tar distilled with the crude vinegar. "It exists in the tar of beech woods to from 20 to 25 per cent., and in crude pyroligneous acid to the amount of $1\frac{1}{2}$ per cent."*

Acetic Acid.—"The crude acid is rectified by a second distillation in a copper still, leaving about 20 per cent. of tarry matter; it has now become a transparent brown vinegar, and its acid powers are 50 per cent. superior to household vinegar. By redistillation, saturation, evaporation, conversion, &c., a colorless strong vinegar is obtained, which is well known as the acetic acid of commerce," and is the vinegar used in large pickle manufactories, and imported here under the name of pale malt and white wine vinegar, with and without pickles, in large quantities.

Green hardwood timber is best for charcoal, and yields the largest quantity of wood vinegar.

Salts of Vinegar.—"When acetic acid is concentrated it becomes a very powerful scent, and is used in sickness and fainting fits. Salts of vinegar is sulphate of potash impregnated with acetic acid, and rendered aromatic with the oil of rosemary, lavender, &c., and is sometimes called "aromatic vinegar."*

GIN.

In 1858 we imported gin to the value of £108,268.†

The manufacture of *Hollands* or *Geneva*, as pursued in Schiedam is as follows:—Two parts by measure of unmalted rye, and one part of malted *bigg* (a light small grained kind of barley), are steeped together in a mash tun for about two hours, the water being added at about 165° Fahr.; the contents are vigorously

* Dr. Ure.

† In 1859 we imported gin to the value of £109,992.

stirred and the mash tun closely covered up immediately after. After two hours steeping, the *transparent* spent wash of a previous mashing is then added with as much cold water as will reduce the whole to about 85° Fahr. Flanders yeast is then introduced to the amount of one pound for every 100 gallons of the mashed material. The fermentation occupies from 48 to 60 hours, when the wash is transferred to the still, and converted into *low wines*; to every 100 gallons of this liquor two pounds of juniper berries and a quarter pound of salt are added; the whole is then put into the low wine still, when the fine Hollands spirit is drawn off by a gentle and well-regulated heat." "The quantity of spirit varies from 18 to 21 gallons per quarter of grain," the spirit being 2 or 3 per cent. above proof, "this large product being partly due to the spent wash of the preceding fermentation, which also improves its flavor." The quantity of rye, and (bere or bigg) grown in Victoria during the year ending the 31st March, 1860, was 2714 bushels, showing an increase over the preceding year of 2063 bushels. I have no official information as to the use that is made of these cereals; but on referring to my article on "Brandy," it will be seen that illicit distillation is carried on to a large extent throughout the colony. Were distillation to be legalised, doubtless much of the £108,000 now annually spent for gin would be retained in the colony.

The preceding information on the manufacture of Hollands is abridged from Dr. Ure's article on gin, the details of which he obtained from a distiller who had studied the art at Schiedam, and who tried to bring it into general use in Great Britain, "but found the palates of our gin-drinkers too much corrupted to relish so pure a beverage." From this it is clear that Dr. Ure considers Hollands more wholesome than British gin, about which latter article he is ominously silent.

We already grow rye and bigg in Victoria. Juniper berries are grown here; they are not in request for this purpose, but would be if distillation was allowed by license at a low rate of duty per gallon, when we could compete successfully with the imported spirits, both as to quality and cost.

GLASS.

In 1858 we imported plate glass to the value of £12,213, and window glass valued at £16,450; since then the importation of

plate glass has greatly increased. In the first six months of 1860 we imported bottles to the value of £1850 (exclusive of those containing liquors, &c.) and glassware valued at £22,000; we may therefore safely take our annual importation of glass at not less than £60,000.* Without entering into the tedious details of the manufacture of glass, I will give a few recipes of the materials used in making certain kinds of glass, and then show that these materials are either among the raw materials of Victoria, or can be made from them, with one or two trifling exceptions.

"Bottle Glass.—Yellow or white sand, 100 parts; kelp (burnt seaweed), 30 to 40; lixiviated wood ashes, from 160 to 170 parts; fresh wood ashes, 30 to 40 parts; potter's clay, 80 to 100 parts; cullet or broken glass, 100. If basalt be used the proportion of kelp may be diminished."†

In the best bottle glass, as the *flask glass* of St. Etienne, some *heavy spar* or sulphate of barytes may be used, but only to the extent of about 1 per cent.; this last is the only article that need be imported for the manufacture of any kind of bottle glass.

"Crown Glass.—300 parts of fine sand; 200 of good soda-ash; 33 of lime; from 250 to 300 of broken glass; 60 of white sand (or crushed quartz); 30 of purified potash; 15 of saltpetre (1 of borax); $\frac{1}{2}$ of arsenious acid."†

The soda ash is crude carbonate of soda made from sea salt, and could be made from the saline deposit of our salt lakes; the potash is made from calcined vegetable matter such as thistles, straw, &c. (see Potash); saltpetre is a natural combination of potash and nitric acid, hence called nitrate of potash; the arsenious acid is obtained from various metallic ores found in Victoria, but as it only forms about $\frac{1}{1300}$ part of the materials used for crown glass, and about $\frac{1}{150}$ part of some kinds of crystal glass, it is an insignificant item in the manufacture of glass, and could be imported.

"White Table Glass.—100 of sand; 50 of purified potashes; 20 of chalk (or pure limestone); and 2 of saltpetre."

* In 1859 the value of imported glass was, for bottles, £4,920; plate, £17,860; window, £22,895; and glassware, £23,522; total, £69,197.—C. MAYES, June 29, 1861.

† Dr. Ure.

"*Crystal or Flint Glass.*—60 parts purified potashes; 120 sand; 24 of chalk (carbonate of lime); 2 of saltpetre; 2 of arsenious acid; $\frac{1}{8}$ of manganese." Manganese (oxide of) has been found associated with the lithographic limestone of Geelong.

Another *Crystal Glass* which is fit for optical and chemical purposes, is made with "120 white sand (or quartz); 40 of purified pearlash; 35 of red lead; 13 of saltpetre; $\frac{1}{8}$ of manganese."* Pearlash, like potash, is a preparation of calcined vegetable matter. Red lead or minium is prepared by calcining common lead with a slow fire, lixiviating it, &c.

"*Plate Glass.*—Very white sand (crushed milk-white quartz), 300 parts; purified soda, 100 parts; carbonate of lime (pure limestone), 43 parts; manganese, 1; cullet or broken plate glass, 300."* These are the materials used for mirror plate glass on the Continent of Europe, the purified soda is *carbonate of soda* (see article on "Soda.") There are other kinds of glass, such as *green window*, or *broad glass*, the common *dark green bottle glass*, &c., the last two being cheap inferior glasses. An improved *broad or spread window glass* is made in Birmingham, &c., under the name of *British or German plate glass*. *Chance's British sheet glass* is made in the same way, but with the materials used for crown glass.

Kelp and Soda Ash.—Kelp, or calcined seaweed, which used to be largely used in the manufacture of glass, is now superseded by the economical manufacture of carbonate of soda and soda ash from sea salt, which from its well known invariable properties, can be safely depended upon, whereas kelp, from its variable constituents, was too often a source of annoyance and loss to the glass manufacturer.*

Saltpetre or nitre, one of the materials used in making crown, crystal, or flint and plate glass, could be made here from *nitre beds*, as practised in Sweden and France (2000 tons fit for the manufacture of gunpowder were annually made in France during the wars of the Revolution); but as it is a natural efflorescence from porous stones and the surface of the ground in certain parts of Spain, Egypt, India, &c., it could always be imported much cheaper than it could be made, the three last named countries generating sufficient for the wants of the whole civilized

* Dr. Ure.

world, since it almost unaccountably re-appears annually after the surface of the ground, stones, &c., has been carefully cleared of the previous crop.*

Indigenous Materials.—It will be seen from the foregoing remarks that in materials for glass making we are not inferior to any other civilized country in the world, since we possess inexhaustible supplies of fine white sand or quartz, the principal material of glass, and can either manufacture or import all other necessary materials. It is to be hoped that the time is not far distant when the pure white sand of our beaches and the milk-white crushed quartz of our gold-fields will be sought for this purpose. I recollect reading many years ago that the sea-sand on the coast of Gipps Land was unsurpassed for its purity and whiteness by any other sand for the manufacture of the best kinds of glass, and that it had been imported into England for that purpose.

Furnaces.—In the construction of the furnaces, which seldom last more than twelve months, and therefore form an important item in the current expenses of glass making, fire-bricks are required made from equal portions of silica and alumina, or pure quartz sand and washed clay, as described under "Brick Earth," in the article "Bricks" (which see).

Fire Clay.—The melting pots are also made from a superior kind of fire clay, mixed with broken pots or crucibles, as shown under "Pottery" (which see).

Slip.—Instead of lime or cement mortar (which is fusible), a fire-mortar is used called *slip*, which is made from the constituents of fire-clay, ground, washed, and properly mixed by passing it through a hair sieve; this mixture is used to connect the fire-bricks, and as a substitute for mortar in the furnaces.

Polishing and Grinding plate glass is done by machinery, the last or finishing polish being the work of females in France, "who slide one plate over another while a little moistened putty of tin finely levigated is thrown between."†

Silvering Plane Mirrors "consists in applying a layer of tin-foil alloyed with mercury to one surface."† This process is now carried on in Melbourne, by Messrs. Ramsay Bros., where a mirror 10 feet by 7 feet has lately been silvered, and is described in the

* See article on Glass, by Dr. Ure.

† Dr. Ure.

Argus (about August 5, 1860). The tinfoil, which is rather larger than the glass, is covered with mercury and amalgamated with it by rubbing the mercury over the tinfoil; the glass is then slid on to the tinfoil, the mercury being pushed before it; it is then pressed down by a large number of covered weights, which remain upon the glass for about thirty-six hours. This process differs little from that described by Dr. Ure, who, however, states that about a month is required for draining out the superfluous mercury from large mirrors, and from eighteen to twenty days from those of moderate size.

Fuel.—In regard to the kinds of fuel used in the furnaces, Dr. Ure says: "Formerly wood fuel alone was employed for heating the melting furnaces of the mirror-plate manufactory of St. Gobin; but within these few years, the director of the works makes use with nearly equal advantage of pit-coal. In the same establishment two melting furnaces may be seen, one of which is fired with wood, and the other with coals, without any difference being perceptible in the quality of the glass furnished by either." * * * "The construction of the furnaces in which coal is burned is the same as that with wood, with slight modifications. Instead of the close-bottomed hearth of the wood furnace, there is an iron grate in the coal-hearth through which the air enters, and the waste ashes descend."

"When billets of wood were used as fuel they were well dried beforehand, by being placed a few days on a framework of wood called the wheel, placed two feet above the furnace and its arches, and supported on four pillars at some distance from the angles of the building."

There are many localities where glass might be made with advantage, such as a white sandy beach accessible by small vessels, and having plenty of wood or coal in the neighborhood; also, on the banks of our salt lakes, supposing the sand to be suitable, fuel near, and the locality easy of access; all these prerequisites are probably attainable.

In these two supposed localities the soda could be made on the spot from the sea water of the beach, or salt found on the banks of our salt lakes. Should it be deemed inadvisable to manufacture the soda, the other ingredients, sand and fuel, might be obtained in hundreds of places in the colony, and even quartz-crushing for gold and sand carried on simultaneously.

GLUE.

In 1858 we imported 20 tons of glue, valued at £2030, or about £101 per ton.* Glue is the substance gelatine in a dry state, and is prepared from the parings of ox, horse, and other thick hides, and the refuse of the leather dresser, which afford 50 per cent. of their weight in glue. The tendons and similar offal of slaughter-houses also afford materials for glue, but it is inferior to that made from those first named. Skin of any kind, if uncombined with tannin, will make glue; the tannin is inseparable from the glue by any known chemical process, and this is why leather cannot be made into glue. The skins must be thoroughly cleansed before being used for this purpose by macerating in milk of lime. They are then, with other animal matters, boiled in a copper, with a false bottom to prevent the glue from burning; after being boiled for a certain time, the jelly formed in the bottom of the copper is drawn off by a stop cock; the first boiling is always the best, the second and third being weaker, and are again used for boiling fresh animal matter; the jelly, after being drawn off for glue, is kept hot for five hours to settle, the clear solution being then drawn off into casting boxes, which remain all night, when they are turned out on to tables, cut up into the required form, and suspended in nets to dry; if the weather is too damp for this purpose, the glue is dried upon hurdles in a drying-room, heated with a stove. "The pale colored, hard, and solid glue, made from the parings of ox or horse hides by the first boiling is the best and most cohesive."†

In 1858, we exported 166,811 skins, besides 311,013 horns and hoofs; there were also fifty-eight fellmongeries and tanneries in the colony at the same time;‡ from these combined sources it is probable there was ample waste material for at least 20 tons of glue, the quantity imported in 1858.

The Victoria Glue Company now have works at Sandridge.

* In 1859 we imported glue to the value of £3534, showing an increase as compared with 1858.—C. MAYES, June 29, 1861.

† Dr. Ure.

‡ In 1859 we exported 251,293 skins, and 295,503 horns and hoofs, weighing 28 tons 12 cwt.; at the same time there were 20 fellmongeries and 31 tanneries in Victoria.—C. MAYES, June 29, 1861.

HATS AND CAPS.

These articles of apparel were imported here in 1858, to the value of £85,173, but during the first six months of the present year, 1860, the importation has fallen to £32,000, as compared with £42,000, the amount for the corresponding period of 1859.*

"The materials used in making stuff hats are the *furs of hares and rabbits freed from the long hair*, together with wool and beaver."† We have but few rabbits in the colony; but, as a substitute, we have a large number of opossums and kangaroos, wallabys, wombats, &c., whose furs might be applied to hat making, the long hair being used for the manufacture of felt for this and other purposes.

The skeletons or shells of stuff hats are made of whalebone, horsehair, paper, &c., which are washed over or saturated with a waterproof composition; the nap is then worked on to the shell by being dipped into a hot *liquor* and rolled. There are many operations connected with hat-making which would be too tedious to describe; but most of them can be effected by machinery, such as separating the nap from the long hairs by a kind of winnowing machine; machines may also be had for making the shells, ironing the hats, *roughing* or working the nap on to the shell or skeleton of the hat, &c.

With the exception of silk and beaver, we have all the materials required for hat-making; these are whalebone, wool, and horsehair, and the furs of animals, as abovementioned, which are also suitable for the manufacture of felt, either for hats and caps, or for other purposes to which felt is applied, as for roofing, coating boilers of engines, as a non-conductor of sound between partitions of cabins, &c.; for these latter purposes the hair of oxen, horses, &c., is also made into felt. Every imported hat costs 3s. for freight, cases, insurance, &c., which would be saved if they were made here.‡

* In 1859 we imported hats and caps to the value of £86,153.

† Dr. Ure.

‡ From the evidence given before the Tariff Committee, in March, 1860, I abstract the following:—"There are from 100 to 150 journeymen hatters in Melbourne, and only about 12 employed at their trade;—that a man can make 18 black silk, felt, or shell hats in a week, for which he would be paid from £3 to £3 12s." That imported hats are inferior to those made in

Straw Hats and Bonnets.—In the list of imports for 1858, no mention is made of bonnets, which are probably included under drapery. The number of Italian or Leghorn, Tuscany, and English straw bonnets imported here must be considerable, if we consider that only a portion of our population, say 50,000 females, were to require even one straw bonnet during the year, at an average value of 10s. each, it would amount to £25,000. That this estimate is rather below than above the mark will be apparent, since English straw bonnets vary from 5s. to 20s., and Leghorn (worn by ladies) from £1 to £4 each. It is this very expensive kind of bonnets, the straw for which is exported from Tuscany and other parts of Italy into England, and there woven or plaited and sewn for bonnets, which we might probably grow and manufacture in Victoria. It appears, from the account given by Dr. Ure, that the Italian and Tuscan straw is made or prepared from the bearded wheat, which is pulled up while the ear is in a soft milky state, and spread out in the sun for three or four days to dry; it is then tied up into sheaves and stacked for about a month, when it is removed to a paddock and again spread out to be bleached by the aid of the sun, air, and dew; the roots and the lower joint of the straw is then separated from the stem, leaving the upper part fit for use; it is then sorted according to quality, steamed for the purpose of extracting its color, and submitted to the fumes of sulphur to complete the bleaching. In this state, (the dried ears of wheat being still on the straw), it is imported into England to be split and dyed, the Leghorn being then generally woven, and the Tuscan plaited and sewn. The valuable properties of this straw may be chiefly due to the climate of Leghorn or Italy, which resembles that of Victoria.

HORNWARE.

The horn of oxen, cows, goats, sheep, &c., is a tough, semi-transparent substance, which can be pressed into a variety of forms required for combs, rings, handles for knives and forks, &c. The best process is to boil the horn after being sawn in two, longitudi-

Victoria because they are injured in transit by the dampness of the salt water. That, supposing we could compete with imported hats, nearly as many females as men might be employed.—C. MAYES, June 29, 1861.

nally, and press out the leaves, or sheets, by iron vices; these pieces are then sawn to the required thickness, if for sheets or plates, which may be joined together, by being first fixed in an iron mould, and, while so fixed, plunged into boiling water till the edges are softened, when they are joined and plunged into cold water, the edges being thus perfectly united; horn can be spotted to imitate tortoise-shell by a simple process. Cutting the teeth of combs is accomplished either by hand or by machinery; one of the machines used resembles a lathe fixed with fine circular saws at the requisite distance apart to cut the whole of the teeth simultaneously, the plate, or intended comb, being pressed against the saws for that purpose; another machine, invented by a Mr. Lyne, cuts two combs at once by means of chisels, which prevent any waste of material as in sawing. "The kind of horn most preferred is that of goats and sheep, from its being whiter and more transparent than the horn of any other animals." "Bullocks horns may be softened by roasting in the flame of a wood fire, when they are split up and pressed as before stated." * Without entering into the details of the process of manufacturing rings, handles for knives and forks, knobs for handles of furniture, powder-horns, drinking-horns, snuff-boxes, &c., it may be sufficient to call attention to the fact that in 1858 we exported 311,000 horns and hoofs, valued at £6150; many of the above articles are either turned or made by machinery, so that their cost does not altogether depend upon the value of skilled labor.

IRON.

In 1858 we imported rod and bar iron to the value of £58,942; hoop iron, £2431; iron wire, £12,630.†

Iron Ores of Victoria.—Hitherto iron has not been obtained from the ores of the colony, although they are found associated with coal, fire-clay, and limestone at Western Port, Cape Paterson, and other Victorian coal-fields.

* Dr. Ure.

† In 1859 the value of imported iron was as follows :—Rod and bar iron, £83,981; castings, £6089; galvanised, £85,917; galvanised wire, £3956; hoop iron, £2944; pig (cast iron), £20,485; pipes, £32,055; sheet, £9422; wire, £20,676; undescribed, £3559; railway materials (chiefly iron), £95,830: together equal to £364,914.—C. MARRS, June 29, 1861.

Hæmatite.—The most valuable ores in this or any other part of the world are the red and brown hæmatites, which generally contain about 66 per cent. of pure iron, being about double the per-centage of the carbonates from which nearly the whole of the iron of England is obtained. Hæmatite is found in large quantities in many parts of Victoria, as at Western Port and throughout our numerous and extensive gold-fields, where it generally encases the quartz reefs or veins of the palæozoic or auriferous strata. Titaniferous iron-sand is found in abundance on the eastern coast of Port Phillip Bay, on the coast of Cape Liptrap, and many other places where the tertiary formation occurs. Its commercial value is, however, inferior to hæmatite, unless it is of that kind which is attracted by the magnet, when it partakes more of the nature of magnetic iron ore from which the celebrated Danne-mora, or best Swedish iron is made. The ferruginous sandstones found on the east side of the Bay contain nodules of ironstone as rich in iron as hæmatite; a specimen assayed by Mr. Davey, gave 67 per cent. of iron, and a very little titanium.

Facilities.—We possess, then, fire-clay for the manufacture of fire-bricks, indispensable in the construction of cupolas, or smelting-furnaces; iron ore, with the coal for fuel; and limestone for a flux to assist the reduction, or smelting process; and these materials are generally associated in the coal-fields of Victoria. Independently of this source of iron we have, associated with hæmatitic iron ore, immense quantities of hardwood timber, which is easily converted into the best description of charcoal for smelting purposes; in many such localities may also be obtained suitable limestone for a flux; * fire-clay fit for fire-bricks to construct the cupola, the same clay being a refractory substitute for the mortar, called *slip*, used for the joints of the brick lining; and, lastly, clean silicious sand for moulding.

Iron ores of England.—Previous to 1740 the brown and red hæmatites and the earthy iron ores of England were smelted

* As valuable iron ores are found contiguous or associated with basalt, in many parts of Victoria, where limestone cannot be easily obtained, it would be well worth our while to ascertain by actual trial the value of basalt as a flux for reducing iron ore; it has been long used for this purpose for smelting copper. Basalt and rich iron ore are found associated on Batman's Hill, Melbourne.—June 29, 1861.

entirely with charcoal; but it does not appear that the clay iron ores of the coal measures were then used, although they are the chief source of British iron at the present day. In 1796 the process of smelting with charcoal was almost given up in consequence not only of the scarcity of wood fuel in England, but also on account of suitable iron ore being discovered and obtained from the pits that furnished the coal; from which favorable continuity of iron ore and coal England owes much of her present wealth and wide-spread commerce.

Smelting with Coke.—As before stated, we have a similar combination in our Victorian coal-fields to that last mentioned, and where such localities are near to good shipping places, or have a market within a reasonable distance, it is highly probable that smelting with coke would be found remunerative. Such iron would be softer and more suitable for castings than charcoal iron, although for most other purposes inferior to it.

The iron ore would require to be roasted before being smelted, which could be easily accomplished in the same manner that quartz is roasted on our gold-fields before being crushed, that is by being piled upon a heap of wood, which is fired and allowed to burn out; if the saving of wood fuel should be deemed advisable the ores could be more economically roasted in *running-kilns*. (See "Kilns," in article "Cement and Lime.")

Smelting in England.—The blast furnaces of Staffordshire are constructed almost wholly of bricks, the sides of the cupola being bound with a great many iron hoops, by which a great saving is effected in the thickness of the walls. In South Wales the furnaces are much slighter than those of Staffordshire, and are also higher in proportion to their diameter; they are used chiefly for refining the cast iron preparatory to its conversion into bar and rod iron, boiler-plate, &c., while those of Staffordshire are used chiefly for castings. These furnaces will last from three to seven years without repairs to the lining of the lower part of the furnace, the upper part of the lining lasting much longer.

The consumption of coal per ton of cast iron varies from three to four tons; the quantity of limestone required as a flux is about one-third the weight of unroasted ore (carbonate of iron), which yields about one-third of its weight of pure iron, therefore the quantity of limestone required is about equal in weight to the

iron produced from carbonate of iron, or clay ironstone, the kind of iron ore generally found in combination with coal.*

The blast of air supplied to blast furnaces is produced by the rapid revolution of a fan enclosed in a box open on one side to admit the air, which is propelled from the circular case, or box, into a pipe leading to the hearth, or crucible, of the furnace; this pipe may supply any number of branch pipes with compressed air, and any of these may be heated by furnaces before entering the tuyeres, or blowpipes, of the blast furnace.

Hot blast.—The hot blast is generally supplied at from 612° to 662° Fahr., and produces about 50 per cent. more iron in a given time, with the same amount of fuel. The coal is always carbonised, or converted into coke (before being used for smelting, or refining, iron), by which means most of the sulphur in the coals is driven off which would otherwise materially deteriorate the quality of the iron.

Although the quantity of iron produced in a given time, from the same amount of fuel, is so much in favor of the hot blast over the cold blast furnace, even to the extent of 50 per cent., (or, to put it in another form, one-third of the fuel may be saved by using the hot blast,) and, although a much greater heat can be obtained, by which means finer and thinner castings may be made, it seems strange it has not come into general use in Victoria, where the saving in fuel, one would imagine, would be of almost paramount importance. I am not aware of even one foundry in the colony where the hot blast is used; it may be on account of the additional outlay in capital required to construct the air-heating furnaces.

The *finery furnace*, or *running-out fire*, is a smelting hearth, in which, by first fusing, and then cooling, crude cast iron, it is converted into *fine iron*, for making malleable iron by *puddling*.

"Whatever care is taken in the process of fining, the bar or plate iron finally resulting is never so good as if charcoal had been used in the refinery."*

The *puddling furnace* is of the *reverberatory* form. In this furnace the fine iron, prepared by the refinery furnace, is *puddled* or worked about with a rake, by which process the oxyde of carbon is disengaged from the iron, which is worked up into balls, to be afterwards forged or beat out, and then rolled into sheet, plate, bar,

* Dr. Ure.

or rod iron, as required, by the aid of powerful machinery. "The puddling process lasts from two to two and a half hours, and is attended with a loss of iron of from 8 to 10 per cent., even when skilfully manipulated. In Wales the consumption of coal is equal in weight to the fine metal puddled. About five puddling furnaces are required for the service of one smelting furnace and one finery"*

The forge hearth is employed for working up *scrap* into boiler plate, sheet, bar and rod iron, &c.: as before stated, wood charcoal is the best fuel for this purpose. "About 22 bushels, or 4 cwt. of charcoal are consumed in making one ton of iron of this description, from boiler-plate parings."*

Swedish bar, imported into England at about three times the price of English iron, where it is used chiefly for conversion into the best cast steel, is made from hæmatite, smelted, refined, and puddled, with charcoal fuel. In Sweden it yields only 47 per cent. of cast iron, with a consumption of 130 per cent., by weight of charcoal, as compared with the weight of cast iron produced.

The furnace used to produce so small a per centage of iron, from hæmatite, with so inadequate an expenditure of fuel, is elliptical, 30 feet high, and 8 feet smallest diameter, and is worked with forge-bellows, mounted with leather. Were proper hot blast furnaces to be used, the results should not fall short of the blast furnaces of Staffordshire or Wales; the force or pressure of the fan blast would require to be modified, to prevent the charcoal being blown out of the furnace, or some other, and perhaps more efficacious method could be arrived at by actual experiment to attain this desirable result.

Charcoal Iron, the best Iron.—The most valuable iron is made from hæmatitic iron ores, smelted, refined, and puddled, with charcoal, and bar iron, made in this manner, is the best iron for conversion into all kinds of steel. I have before shown that we possess hæmatitic iron ores in abundance, often in contiguity with hardwood, which is easily converted into excellent charcoal, so that it is possible to make the best iron and steel in such localities, but we must invent some more efficient process than that pursued in Sweden, where only one cwt. of cast iron is produced for each ton obtained from a blast furnace of the same size in Staffordshire or

* Dr. Ure.

Wales. This great difference is due chiefly to the absence of the blast fan in the Swedish furnace before referred to, and the small quantity of charcoal used for each ton of iron produced.

Victorian Iron.—The forging of a horse-shoe is considered to be a good test of the quality of iron. At the Melbourne Exhibition of 1851, a specimen of native iron was exhibited from Western Port, and a horse-shoe made from it, superior in density and texture, to the generality of horse-shoes, so far as I could judge from a casual inspection. A large specimen of native iron from the same place, is now (September 1st, 1860), to be seen in Mr. Norton's shop-window, in Collins-street east.

Iron-rolling mills have been recently opened in West Melbourne, for the manufacture of bar and rod iron, from $\frac{1}{4}$ inch square or round, up to $2\frac{1}{2}$ inches. The material used is old or scrap iron, which is cut to the proper length and made up into fagots of about 30 lbs. each. They are then subjected to the furnace, from a half to three-quarters of an hour, drawn out in fused masses, and rolled into bar or rod iron. The fuel used is coal, and the iron produced is at least equal, if not superior, to that imported. Several specimens of bar and rod iron, from this manufactory, were submitted to the Royal Society of Victoria, but it is only from actual experiment that the peculiar characteristics of iron can be ascertained with certainty. It is well known that coal, as a fuel, renders the iron softer and more ductile than the same iron would be, if prepared or manufactured with hardwood charcoal. If it should be deemed advisable to convert the waste iron of the colony into sheet or plate iron, or into bar iron, to be afterwards made into steel, hardwood charcoal would be found to be the best fuel for the purpose, although in Melbourne it would cost about double the price of coal, or at least £4 per ton, although on many of the gold-fields it is made for about 50s. per ton.

Natural Steel may be produced in the conversion of cast into wrought iron, by a slight difference in the working; this may be more readily understood, when we consider that steel is merely carbonised iron, and that cast iron, which generally contains more carbon than steel contains, is deprived of its carbon in refining and puddling, the process employed for its conversion into wrought iron. "In Sweden, the cast iron pigs are heated to a cherry-red, and in this state broken to pieces, under the hammer, before they are exposed to the steel furnace. These natural steels are much

employed, on the continent of Europe, in making agricultural implements, on account of their cheapness. Natural steel is made in large quantities at the celebrated steel iron works of Upper Silesia, in Germany. The natural steel of Styria is also regarded as a very good article. Wootz is a natural steel prepared from a black iron ore in Hindostan; it is smelted with charcoal, in a small clay furnace, with hand-bellows."*

Hæmatitic Iron.—"In 1837 Mr. N. W. Clay obtained a patent for improvements in smelting and refining hæmatitic iron ores. He mixes bruised hæmatite with 20 per cent. by weight of clean carbonaceous matter, in coarse powder (this may be charcoal, coke or coal dust), and subjects this mixture, in a  shaped retort, to a bright red heat for at least twelve hours; the metal is then transferred into a puddling furnace. In his second patent, in 1840, Mr. Clay prescribes from 30 to 40 per cent. of carbonaceous matter to be mixed with the ground or crushed iron ore, which mixture is to be directly treated in a puddling furnace."* By this last method the fine iron is produced, at one operation, from the crushed iron ore, without a smelting furnace. Such a method of obtaining refined iron fit for immediate conversion into malleable iron, in the shape of rod, bar, plate, or sheet iron, is well worth a trial on our gold-fields, where hæmatitic iron ores are generally found encasing and permeating our quartz reefs. Even the iron cement of our gold-fields might be found profitable to convert either into cast or malleable iron, where both charcoal and limestone are easily obtained. It is not necessary that a large outlay should be made to construct iron works or foundries for the purpose of trial. The process of reducing iron ores, either into cast iron or natural steel, is so simple, that two men with fire-clay, hæmatite, or other rich iron ore, charcoal, limestone, and a forge-bellows at hand, could construct a fire-clay cupola or furnace, prepare and smelt say one cwt. of cast iron in about two days, and could reconvert this iron into steel, in the same furnace, in a few hours.

Hindoo Iron and Steel.—All that is necessary to convert iron into steel is to make several refractory or fire-clay retorts, into which "the cast iron is placed in small pieces, mixed with charcoal powder in the retorts, which are placed in the small blast furnace, kept covered with charcoal, and subjected to heat urged

* Dr. Ure.

by the blast of the forge-bellows for about three hours. The crucibles or retorts are then taken out of the furnace and broken, when the steel is found in the form of a cake in the bottom of the crucible.* This is the system pursued by the natives of Hindostan for obtaining iron and steel, only they have no proper forge-bellows, but merely a goat's skin with bamboo nozzle and handles, which must be a miserable substitute for proper forge-bellows. Then, again, instead of putting several pounds of iron into each crucible with powdered charcoal, they seldom put more than one pound, the retort being filled up with dried chopped wood; yet, with such rude materials and miserable appliances, the best cakes of Indian steel, when remelted and tilted, or hammered into rods, are stated, by a very competent judge, to be "superior to the best English cast steel for fine cutlery."*

I am credibly informed by a gentleman, long resident at Pleasant Creek gold-fields, in the Ararat district, that cast iron basins for quartz-crushing, weighing about three cwt. each, are sold there for £12 each; similar cast iron basins could be obtained in England for about 30s., and could be made on our gold-fields probably for about £3 each. It is more than probable that in every locality throughout the colony, where the cartage from Melbourne exceeds say £5 per ton, and where fire-clay or any kinds of refractory clay, rich iron ore, limestone, and charcoal are at hand, that all kinds of iron and steel could be manufactured equal in quality to and at the price of that imported.

Nails are made by machinery, with but very little assistance of the human hand. It is in such manufactures, requiring little manual labor in their production, that we can most easily compete with imported articles, since the cost and working expenses of machinery, as compared with manual labor, are smaller here than in Britain, America, &c.

So far back as 1810 the Americans possessed a nail machine that could turn out 100 nails per minute, cut and headed at one operation. The manufacture of cut nails by machinery originated in America, and they are equal to wrought nails where they do not require clinching, which may be considered an exceptional practise in using nails. The rolling and slitting mills of America cut up about 2400 tons of sheet iron per annum into nails and

* Dr. Ure.

brads. At least ten patents were taken out in England between 1820 and 1836 for improvements in the manufacture of nails. I do not know what improvements have taken place since, but the description of the machines and improvements up to 1836 appear to leave little to expect in the shape of improvements, so far as I can judge from the information given by Dr. Ure on this subject. The machinery in the rolling and slitting mills prepare the rods from plate or sheet iron, preparatory to their conversion into cut nails.

In 1858 we imported nails and screws weighing 1983 tons, and valued at £64,302. Probably at least three-fourths of this amount was for nails, which might be advantageously manufactured in Victoria, where the bar and sheet iron can be made from our raw materials.

Founding.—From the evidence given before the Tariff Committee on the 9th March, 1860, an eminent iron founder of Melbourne stated that “manufactured articles made here were about two and a half times the English price, and that the iron founders of Melbourne could not compete with imported articles, except in gold-crushing machinery. That wages were three times as high here as in England, but that suitable mechanics were continually offering their services at half the present rates,” showing that the demand, on account of the high rate of wages, was small compared to the supply, and yet there is an evident disinclination on the part of the iron founders of Melbourne to reduce the rate of wages, so that the high price of machinery here is simply the result of an arbitrary trade combination, and any attempt to reduce the wages of mechanical engineers, although for the mutual benefit of the iron founders, their workmen, and the public requiring machinery, would probably lead to a general strike on the part of the men, who now hold the iron founders, and the purchasers of their labor, in subjection, while at the same time not more than one-half the mechanical engineers in the colony are employed, so that, as a body, they are poorer than if they worked for one-third less than at present, when the whole of them might be employed. The same gentleman also stated that “if a new firm were to start with men at less wages than we are paying, we might reduce the wages of our men, in order to compete.” Another founder stated “that although there was plenty of ironstone in the country, that there was not sufficient fuel here to manufacture iron.” One

would suppose that this gentleman was never ten miles out of Melbourne, or he would not have made such a random statement. There are numerous densely timbered forests in the colony abounding in ironstone; and it is a fact that charcoal may be obtained at Pleasant Creek, and other gold-fields, at less than one-half the price (by weight) of imported coke in Melbourne.

In addition to the abundance of rich iron ores, in combination with either coal or timber, we also have tin ores, which we now export, and can also import any quantity of copper from South Australia, so that iron founders might, in many instances, establish iron-works in many of our inland towns, and if near to a proposed railway, might manufacture the rails and chairs required for the permanent way, the iron girders for the railway bridges, besides innumerable other less weighty articles required, not only for railways, but for quartz-crushing and other machinery; also iron pipes for water-works and gas-works, now the general concomitants of most towns. Although iron founders cannot compete with imported goods or articles in Melbourne at the present rate of wages, yet, as before stated, in certain localities, where the carriage amounts to say more than £5 per ton from Melbourne, it is probable they could successfully compete with most kinds of iron work.

Waste heat.—It must be apparent to most people who have seen the flames bursting out of the tops of the cupolas in which iron is reduced, or pig iron smelted, that great loss of heat must arise therefrom. "In Germany these waste gases have been collected and used as fuel in refining, puddling, and welding furnaces, and even in the generation of steam from steam engine-boilers."* This may be a desideratum where fuel is very expensive.

Victorian Iron.—Since writing the foregoing article on iron, I have been informed by an iron founder in Melbourne that a company is about being formed to establish iron-works about a mile and a half from Sandhurst, near the railway, where there is an abundance of hæmatitic iron ore, with timber, &c., required on the spot. The company contemplates being able to make iron rails for the railway at £8 per ton, or about one-half the cost of the

* Dr. Ure.

imported rails at Sandhurst. Charcoal iron would be far too good for such a purpose, when we consider it makes much better steel than the common or coke iron.

Cost at Sandhurst.—Since two and a half tons of coke is the average consumption in the Staffordshire iron-works for reducing one ton of iron from the iron ore by the cold blast, and one and a half ton by the hot blast furnace; and as charcoal produces fifteen per cent. more heat per ton than coke, and hæmatite contains twice as much iron as the carbonate of iron of England, and therefore only half the bulk, we may safely estimate the charcoal required to reduce hæmatitic iron ore by the hot blast furnace at two tons per ton of iron; this at Sandhurst would cost about £5; the lime required for flux would cost about 10s.; the labor at double the cost in Staffordshire would be 30s.; to which may be added 20s. for the ore, motive power for blast fan, &c., making a total of £8 per ton for charcoal pig iron. This would have to be refined, and rolled into rails, which would increase the cost to about £14. For the same price it could be rolled into rod and bar iron, which, being charcoal iron, would be worth at least £20 per ton in Melbourne, or £25 per ton at Sandhurst.

STEEL.

“With the exception of the Ulverstone charcoal iron, no bars are manufactured in Great Britain capable of conversion into steel equal in quality to that made from the Madras, Swedish, and Russian irons so largely imported for that purpose.”* As before stated, charcoal iron is made from hæmatite, smelted and *puddled* with charcoal. We could make such iron here, having the raw materials largely distributed.

“*Bar or Blistered Steel* is merely carbonised iron rods or bars: the process of manufacture is simple, and consists in placing the bars of iron in a *trough* made of fire-clay or fire-tiles; the iron bars are in layers placed on edge a short distance apart, and imbedded in *cement*, (a mixture of ground charcoal and common salt,) as follows: the bottom of the trough is covered with

* Dr. Ure.

cement about two inches deep, and between each layer of iron is a layer of cement about half an inch deep; the *trough* or *troughs* (for there are generally two in each furnace) are surrounded by heated air, i.e. the flames of the furnace play round them as with gas retorts; they are sometimes from twenty-six to thirty-six inches square inside, and from eight to fifteen feet long, and being filled to within a few inches of the top, as much as twelve tons of bar iron may be converted into steel at one charge, the process lasting "from six to eight days for steel of moderate hardness, fit for tilting (or hammering) into shear steel; softer steel for saws and springs takes a shorter, and harder steel for cold chisels used in cutting iron, a longer period. The higher the heat of the furnace, the quicker is the process of conversion."*

Cast Steel is merely blistered steel broken up and melted in fire-clay crucibles.

In 1858 we imported 204 tons of steel, valued at £56 per ton.† We can manufacture steel here with advantage, seeing that we have the raw materials of the most approved kind for the manufacture of charcoal rod and bar iron similar to that of Ulverstone, Sweden, India, &c., and also abundance of hardwood charcoal (which is far superior to any kind of softwood charcoal) with the necessary refractory or fire-clays for conversion into fire-lumps, fire-bricks, fire-tiles, &c.; gritstones or millstone grits for the *hearth* of the furnaces, limestone as a flux in smelting iron, and fire-clay for the joints of the brickwork, for *luting* joints of *tap* or *trial* holes, &c., used for testing the quality of the steel from time to time during its *cementation*.

JEWELLERY.

From the evidence given before the Tariff Committee, on the 2nd March last, I glean the following:—There is a protective duty in England on imported gold jewellery of 17s. 6d. per ounce, and 2s. 6d. per ounce export duty from Victoria, making a total of 20s. per ounce on jewellery made here for exportation to England. There is also a duty of thirty-three per cent. on jewellery imported

* Dr. Ure.

† In 1859 we imported 223 tons 3 cwt. of steel, valued at £12,711.—C. MAYES, June 29, 1861.

into America, so that both England and America are effectually closed as markets for jewellery made in Australia. Although the wages paid to working jewellers in Victoria are about ninety per cent. higher than in England, if the same import duties were levied here as in England, our jewellers could compete with imported jewellery, which amounted in 1858 to the value of £44,265.* There is no good jewellery imported into Melbourne, although many people may be tempted to purchase it as such, for instances have been known of imported gold jewellery of twelve carats, sent here to be sold as colonial jewellery of eighteen carats fine. To prevent this nefarious practice, a Goldsmiths' Hall is very much required, which would materially lessen the present enormous import of inferior jewellery, because it would have to be scraped or cut before it could be assayed, whereas colonial jewellery might be assayed in an unfinished state (before the gems were set for instance) by ascertaining its specific gravity, or by scraping or cutting, since any slight abrasure might be obliterated or rectified in the finishing. First-class jewellery is almost exclusively made by hand, whereas inferior jewellery is assisted by machinery, dies, &c.

LEATHER.

In 1858, according to our Blue-book, sixty-three tons of leather were imported, and valued at £9200, or about £146 per ton, whereas in the same year fifty-five tons were exported at only £90 per ton;† this was colonial leather, and, judging from the price, little of it was curried, being sole leather chiefly, since but little curried, or upper leather, is made here, in consequence of the great expense attending its manufacture.

The materials employed in the manufacture of leather consist of the hides of cows or oxen, buffaloes, and horses, which are used for the thick sole leather; and the skins of calves, kangaroos, kids, goats, seals, &c., for the more flexible upper leather of boots and shoes. In the conversion of hides and skins into leather the principal material employed is tannin contained in the bark of various trees,

* In 1859 we imported jewellery to the value of £44,067.—C. MAYES, June 29, 1861.

† In 1859 we imported 66½ tons of leather valued at £10,481, and exported 143 tons 11 cwt., valued at £10,316.—C. MAYES, June 29, 1861.

more particularly our Australian wattle, which is the most valuable bark obtainable for this purpose. In 1858 no less than 166,811 skins, and 124,580 hides, were exported from Victoria, which were valued at £106,463; * this is exclusive of the hides manufactured here into sole leather. In the same year we exported 249 tons of bark, valued at £2800, and these materials have to travel about 30,000 miles before they return to us in the form of leather, boots and shoes, or saddlery and harness. We can produce sufficient hides, skins and wattle-bark to be made into leather for these purposes.

There is evidently a large amount of sole leather prepared from hides in this colony, since in 1858 there were no less than thirty-three fellmongers' establishments, and twenty-five tanneries, three of each, only, being in the county of Bourke; on the other hand, that very few skins are prepared here for upper or light leather, may be inferred from the fact that such leather is curried, and in 1858, according to the Blue-book, there was only one currying establishment in Victoria, and that was in the county of Grant; † this trade is sometimes combined with tanning, although I have reasons to suppose it is but little practised here on account of the great expense as compared with the cost of importing curried leather, and this difference in the cost is entirely owing to the high price of labor attending this process.

In the Melbourne Exhibition, in 1854, could be seen excellent specimens of hide leather tanned with mimosa bark, suitable for harness and boots; since then great improvements have been made, and excellent samples of leather exhibited at the annual exhibitions of the Industrial Society; colonial-made sole and harness leather is now preferred to the imported article.

Parchment is also made here, and samples were to be seen at the Melbourne Exhibition, in 1854. As this is a great wool-producing colony, we might manufacture parchment from sheepskins, not only sufficient for our own consumption but also to export largely; here again the high price of labor stands in the way.

Varieties of Leather.—Other kinds of leather might be made

* In 1859 we exported skins and hides to the value of £172,422, and bark to the value of £1310.—C. MAYES, June 29, 1861.

† In 1859 there were thirty-one tanneries and twenty fellmongeries in Victoria.—C. MAYES, June 29, 1861.

here, such as kid and lambskin for gloves; Morocco or Turkey leather from goatskin; kip, or buffalo, from young oxen; upper leather of ordinary boots and shoes from calves' skin, a softer and more enduring upper leather from kangaroo skin; cordovan for harness, and shagreen for cases, boxes, bags, &c., from horses hides. In the month of May, 1860, an account was given in the *Argus* of the slaughtering of about 800 kangaroos in one day near Geelong; it stated that the kangaroos were afterwards buried or burnt, no allusion being made to the skins, which are even more valuable than calves' skins. I can scarcely imagine (despite the apathy and indifference so often manifested by our should be manufacturers) that the skins of these 800 kangaroos were destroyed.

Harness.—Under the head of saddlery the imports in 1858 amounted to £74,200, and leatherware £6700, together upwards of £80,000.* I cannot imagine that £74,000 worth of saddles could be imported here in one year; the greater part of this amount must be for what is commonly known as harness, which is made from the hides of oxen, horses, calves, &c., the saddles being made from hogskins. Creditable samples of colonial-made harness and saddles were exhibited at the Melbourne Exhibition in 1854, and since then at the annual exhibitions of the Victorian Industrial Society, and may now be seen in the numerous saddlers' and harness-makers' shops in Melbourne; they are fully equal, if not superior, to similar imported articles, as their ready sale testifies; by the Melbourne directory for 1860 I find no less than seventy-eight saddlers and harness-makers in Melbourne and its environs. It might be worth while to adapt machinery to reduce the amount of labor bestowed upon this branch of industry, which, in the absence of cheap labor, might reduce our enormous imports of these articles by increasing at a cheaper rate our own production.

Boots and Shoes were imported into this colony in 1858 to the enormous amount of £652,000,† being equal to about 25s. per annum per head for the whole population, or about £5 for each

* In 1859 we imported saddlery (which I infer includes harness, since I do not find any entry of harness) to the value of £42,446, and leatherware to the value of £8069.—C. MAYES, June 29, 1861.

† In 1859 we imported boots and shoes to the value of £607,703.—C. MAYES, June 29, 1861.

family; the retail price is about 50 per cent. more than these amounts, and this is exclusive of boots and shoes made in the colony, so that the expenditure for each family cannot be less than £10 per annum.* If only one half, or £326,000 worth of women's and children's boots and shoes, were imported, and the men and large boys of Victoria were to wear boots and shoes of colonial manufacture I do not think that a larger outlay would ensue to the whole population, for, although the price of colonial-made boots and shoes are about double the price of imported ones, yet, as they are well known (by those who have made the experiment) to wear about two and a half times as long, they are found to be actually cheaper than the imported article. The boot and shoemakers of Victoria need no other protection to their trade than the general reception of this fact, which wants only a trial to convince any purchaser of imported boots and shoes of its truthfulness. There are many reasons for this, among which are the following, viz., imported boots and shoes are slop-made, the work and material both being inferior; the soles consist of two thin pieces, filled up with fragments of leather, the consequence being that the outside casing forming the lower part of the sole soon wears through, and the boots or shoes (if the *uppers* are worth it) must be re-soled; before this sole is half worn through the sides of the boots open, generally from the upper leather giving way, whereas colonial boots are made of the best material, the soles being colonial sole-leather, and the *uppers* of imported calfskin properly tanned and curried; these never, or very rarely, burst or come unsewn; and the soles, which may be obtained of solid leather at least one-quarter of an inch thick, if they do not last out the *uppers*, the *uppers* will generally bear re-soling, when the boots or shoes are again sound, and even then sometimes superior to those imported.

From the evidence given before the Tariff Committee, on the 10th February, 1860, I learn that it is the general opinion of the trade that if a duty (*ad valorem*) of 20 per cent. were levied upon imported boots and shoes, that the colonial workmen could compete with imported goods, which are, generally speaking, very inferior, and last only from one-third to one-sixth as long as colo-

* I have reckoned the Victorian families to average four; the families of the United Kingdom average five each.—C. MAYES.

nial-made articles ; that such a duty would induce the bulk of the workmen who are now engaged in other pursuits to return to their trade, and hundreds of boys and women who would be glad to get into the trade would join them. That although wages here are only 8d. per hour, it is about three times as high as the wages paid to shoemakers in England. All the witnesses examined by the Committee agree that boys would be of great service to the trade, but because the trade is so bad, they will not take apprentices.

Subdivision of Labor.—By a proper subdivision of labor, colonial boots and shoes would be cheapened ; this might be brought about by the boot and shoe makers of the colony forming themselves into a company, and contracting to supply individuals and families with boots and shoes at the same rate they have hitherto paid per annum for imported goods, which they might do with advantage, even if their goods lasted only twice as long as those imported. By such a combination they might all find constant employment, and also employ hundreds of women in the light work of ladies and children's boots and shoes, and hundreds of boys who would be apprenticed to them ; they would by this means soon outstrip their contract orders, and obtain a large stock of superior ready-made goods, which would soon be bought up as their real value became known.

MALT.

In 1858 we imported 220,777 bushels of malt. The imports for the first six months of 1859 and 1860 show a considerable falling off in the quantity imported.* This is not met by an increase in the growth of barley ; on the contrary there is a decrease in the growth of barley in Victoria during the year ending the 31st March, 1860, as compared with the previous year, of 16,528 bushels, which is not owing to any failure in the crops, but to the fact that there were 1200 acres more under crop in 1858 than in 1859.

Mr. S. Egan, a farmer in Victoria, in his evidence given before the Tariff Committee on 21st February, 1860, says :—"There has been but little barley grown here, because the brewers give no

* In 1859 we imported 198,791 bushels, valued at £96,164.—C. MATES, June 29, 1861.

encouragement for farmers to grow it. Brewers can purchase malt here at such a price that they will not malt themselves, as it requires a large outlay of capital;" and in corroboration of there being but little demand for barley here, Mr Egan states "that he had sold 1200 bushels of barley last week at 5s. per bushel," being less than the estimated value of 5381 bushels (the whole of the barley) imported in the first six months of the year 1860, which was valued at 6s. per bushel.

With the view of encouraging the growth of barley and the manufacture of malt in Victoria, this gentleman recommends an *ad valorem* duty of "3s. per bushel on imported malt, and 2s. 6d. per bushel on imported barley;" this would have increased the value of barley as then imported to 8s. 6d. per bushel, whereas this same gentleman was compelled to sell his barley at 5s. per bushel. It is very clear from the foregoing facts that there has been a great falling off, not only in the importation of barley and malt, but also in the growth of barley in Victoria, and consequently in the consumption of malt, although the manufacture of colonial beer has rapidly increased. (*See "Beer."*)

From the great care taken in shipping malt for this colony, it is landed here perfectly uninjured by its transit from Britain. "It is packed in zinc cases, hermetically sealed, and surrounded with three-inch deals," as stated by one of the first brewers in Melbourne, in a letter addressed to the Editor of the *Argus*, in June, 1860. He also stated in this letter that "four of the principal breweries in Melbourne produce 600 hogsheads of beer weekly, and that the proprietors in the aggregate give a premium of upwards of £100 annually for the best sample of barley grown in the colony, and that he had, at an expense of upwards of £2000, erected a malthouse on his property, in the hope at no distant period of being able to dispense with importations of the principal *ingredients* used in the manufacture of colonial ale, and thus give an impetus to another important but somewhat languishing branch of colonial industry."

About a week after the above letter appeared in the *Argus*, the *Creswick and Clunes Advertiser* gave a description of Quinn's malthouse and brewery in that neighborhood. "The malthouse is a two-story building, the *growing floor* being 8 feet under ground, and made of cement; the tank for steeping the barley is able to contain 200 bushels. The withering floor (which is the upper

floor) is also made of cement; on this floor the barley remains until in a fit state to go to the kiln." There is also an ingenious machine for sifting the malt after it comes from the kiln, and two mills for grinding or crushing it. A moderate and uniform temperature is best adapted for malting, and for this reason the walls of the malthouse should be thick, and if partially underground, as above, a more uniform temperature is most likely to be obtained, at least on the lower floor. A suitable temperature is about 60°, and this would be difficult to maintain during the summer.

Malted barley is generally used in the manufacture of "gin," and "whiskey" (which see). Malt, when used for distillation, should always be of the palest kind, and steam dried; although raw grain is likewise used for this purpose, it is generally mixed with malted barley. "Cape barley would be a good distilling barley, being light," and in this respect resembling "*bere*," which is used in the manufacture of gin. "Barley, if partially malted, will produce from 16 to 20 gallons of spirits per quarter; taking the average crop of barley here at 32 bushels per acre, an acre would produce from 64 to 80 gallons of spirits;" and for this purpose barley would be a profitable crop were it not for the duty of 10s. per gallon levied on all spirits distilled from grain in Victoria. Until this enormous duty is diminished, there is but little likelihood of any considerable quantity of spirits being distilled here.

Brewers also find that they can produce good wholesome palatable beer throughout the colony from other saccharine matter than malt; they therefore use *sugar* as the cheapest substitute for malt. The most conscientious brewer will not brew wholly from malt when it is at its highest price; he only considers himself bound to use saccharine matter of a certain value per barrel of beer; and, therefore, as malt rises in price, the consumption of sugar by the brewer increases. In 1858 we imported sugar to the value of £636,912;* the imports during the first six months of 1859 and 1860 were £398,245 and £347,729 respectively, showing a considerable increase since 1858, whereas the importation of malt during the first period has materially decreased, as I have before shown.

* In 1859 we imported sugar to the value of £803,854.—C. MATEY, June 29, 1861.

OILS.*

Oils, unctuous, fat, or fixed, are generally obtained by expression. Animal fats are granular, and consist of small sacs or bags of fat, which vary in size and shape in different animals. Neats-foot oil is made in the colony, and is used chiefly by harness-makers.

Sperm oil.—In 1858 we imported sperm oil to the value of £7871. Many years before the foundation of the colony, the Messrs. Henty established a whale fishery at Portland Bay, and this locality is still noted for the frequent capture of whales, one of about 60 feet in length having been recently captured and valued at £400. The whale lately killed in Hobson's Bay and tugged up to Sandridge pier, was about the same size. Whales are also occasionally captured in Twofold Bay; and there appears to be a wide field open on our coasts for enterprising capitalists to fit out whaling parties. The blubber of the whale from which the oil is obtained is of great thickness, and has been known to yield upwards of 100 tons of oil from one whale; this is not the only product, since the jaws furnish large quantities of whalebone, and the head, spermaceti, which fills the larger portion of the cavities of the head and certain parts of the body.

Porcine oil, made from *lard*, was very much used for lamps in Melbourne until superseded by *Kerosene* oil, which is distilled from anthracite coal in the United States of America, and is now generally used with the Kerosene lamps throughout the colony.†

Vegetable oils.—Those imported consist of Colza, Linseed, Olive, and Rape oils, of which in the aggregate 83,467 gallons were imported in 1858, valued at £23,313.

Dr. Ure, in his dictionary, gives a list of 41 plants yielding the ordinary unctuous oils of commerce, among which are the Hemp plant, Olive, Almond, Cucumber, Beech, Sunflower, Rapeseed,

* In 1859 the quantity and value of imported oils was as follows:—sperm, 21,899 gallons, £6888; colza, 27,961 gallons, £8506; linseed, 81,871 gallons, £17,944; olive, 10,815 gallons, £2868; and rape, 16,964 gallons, £4561.—C. MAYES, June 29, 1861.

† This information I received from an importer of Kerosene oil, in August, 1860. It may also be obtained from rock oil. See note on "Tar," under article "Gas."—C. MAYES, June 29, 1861.

Castor, Tobacco, Plum, Grape, Cocconut, Palm, Laurel, Groundnut, Colza, Cherrystone, Horse-chesnut, &c.

Colza oil.—Colza oil is an excellent lamp oil, and is produced from a nut grown in France, which yields two-fifths of its weight in oil; it is much used in France, and is also used as a lamp oil in Victoria. The quantity imported in 1858 was about the same as Rapeseed oil, viz., 12,860 gallons.

Rape oil—"Rapeseed oil has a yellow color and a peculiar smell; at 25° Fahr. it becomes a yellow mass, consisting of 46 parts of stearine and 54 of oleine, in which the smell resides." Rapeseed produces about 27 per cent. of oil.*

"*Hempseed oil* has a disagreeable smell and a mawkish taste; it is used extensively for making both soft soap and varnishes."

"*Linseed oil* is obtained in greatest purity by cold pressure; but by a steam heat of about 200° Fahr. a very good oil may be obtained in larger quantity. When kept long cool in a cask partly open it deposits masses of white stearine along with a brownish powder: this stearine is very difficult of saponification. Linseed yields from 20 to 25 per cent. of its weight in oil."*

Linseed.—"The chief difference in the quality of the oil depends upon the quality of the seed used. Heavy seed will yield most oil, and seed ripened under a hot sun and where the flax is not gathered too green, is the best. The weight of linseed varies from 48 to 52 lbs per bushel, 49 being about a fair average; a quarter yields about 14½ gallons of oil, weighing 7½ lbs. per gallon"* It is crushed by machinery with stampers resembling the stampers of quartz-crushing machines, which drive wedges between two bags of linseed, by which means they are effectually pressed, the oil freely exuding during the stamping, and leaving an oil-cake, upon which cattle are fed. "In London a 20 horse-power engine, with 13 light stampers, one hydraulic press of 800 tons pressure, 1 pair of rollers, 2 pair of edge stones, 8 table kettles of a small size heated by fire, will crush two quarters per working hour, with two pressings."*

Linseed Oil Plant.—The Linseed Oil Plant grows in all climates from Petersburg to the East Indies. If grown at all in Victoria it is not to such an extent as to find a place in the Agricultural Statistics of 1858. The best and heaviest seed is generally

* Dr. Ure.

grown and ripened in a warm climate, so that it might be largely grown here, not only for its oil, but also for its refuse or oil-cake.

"*Olive oil* is sometimes of a greenish and at others of a pale yellow color. There are three kinds of olive oil in the market: the best is obtained by pressure when cold; the common sort is procured by stronger pressure, aided with the heat of boiling water; and an inferior kind by boiling the olive residuum with water, whereby a good deal of mucilaginous oil rises and floats on the surface. The latter serves chiefly for making soaps."* The manufacture of olive oil is likely to become an important branch of colonial manufacture, not only for our own consumption, but also for exportation. In 1858 we imported 8715 gallons of olive oil. I am not aware that the olive has been grown to any extent in Victoria, but when we consider the similarity of climate of the countries bordering on the Mediterranean, and Victoria, we may safely predict that the olive will be largely grown here within a few years. Taking the temperature of Naples as an average of the olive-growing countries, and comparing it with Melbourne, I find that the difference of the average heat of either of the four seasons, does not in any instance exceed 5°; the difference in the average annual heat being only 2½ degrees.

Rape, Sunflower, Almonds, Vines, Fruit Trees, &c.—*Rape* has been grown to advantage in the Experimental Farm; the sunflower also grows freely here, as well as both sweet and bitter almonds, plum trees, vines, cherry trees, cucumbers, linseed, &c.; the whole of which, as before stated, produce the unctuous oils of commerce.

Castor Oil, Tobacco, Olive, Colza—Other oil producing plants, the growth of which hitherto in Victoria must be regarded as experimental, may yet flourish here, such as the castor oil plant, the tobacco plant, olive tree, colza oil plant, &c.

"*Oil of Vine Stones* is extracted from the seeds of the grape, which yield about 10 or 11 per cent of oil; it is used as an article of diet,"* and will become worthy of attention as our vineyards increase.

"*Oil of Almonds* is manufactured by agitating the kernels in bags so as to separate the brown skins, grinding in a mill, then enclosing them in bags, and squeezing them strongly between cast-iron plates in an hydraulic press, without heat at first, and

* Dr. Ure.

then between heated plates. The first oil is the purest and least apt to become rancid. Next to olive oil this oil is most easily saponified. Bitter almonds being the cheapest in England, are used in preference for obtaining this oil, and they afford an oil equally bland, wholesome, and inodorous.* Almonds are produced in Victoria in great perfection, although not in sufficient quantities to be used for this purpose at present, but could be whenever the manufacture of scented soaps and other perfumery render it necessary.

Paraffine.—From Dr. Ure's article on paraffine I learn "that it is distilled from beech-tar; in distilling beech-tar pyrélaine passes over, containing crystalline scales of paraffine, which is a white substance, devoid of taste and smell, and feels soft between the fingers; it *burns with a clear white flame*, without smoke or residuum, and has the same composition as olefiant gas. It dissolves readily in warm fat oils, and is a singular solid bicarburet of hydrogen; it has not hitherto (1843) been applied to any use but would form admirable candles." It would appear from this that some one has taken up Dr. Ure's suggestion by dissolving crystals of paraffine in warm oil, and given the compound the name of Paraffine oil, to be used in lamps; an oil is sold in Melbourne as *Paraffine*, which resembles *Kerosene* in many respects, but is darker, smokes when consumed in the Kerosene lamp, and while smoking emits a disagreeable odour: this last oil may be only a substitute for the real Paraffine, or the fact of its smoking in a certain kind of lamp may merely shew that the lamp is not adapted for its perfect combustion; there is at present such a great variety of lamps of different construction more or less in use, that in all probability a more suitable lamp will be found for it.

Oils volatile or essential occur in different parts of odoriferous plants, and in some instances in all parts of the plant, as in thyme, parsley, fennel, sweet marjorem, lavender, southernwood, &c. Some plants, as the orange, furnish different kinds of oil from different parts of the plant; thus the leaves, the flowers, and the skin of the fruit yield each its peculiar oil. "The quantity of oil varies not only with the species, but also in the same plant, with the soil, and especially the climate, it being generated most profusely in hot climates. In flowers it is formed continually

* Dr. Ure.

upon their surface, and flies off at the moment of its formation,"* so that immense quantities of rose leaves (according to the *Athenæum* about 600 lbs.) are required to produce one ounce of the oil or otto of roses; other blossoms, such as violets, orange, acacia, jessamine, hyacinths, and other tuberoses, white lilies, &c., require a much smaller quantity, since 500 lbs. of orange blossoms yield about two pounds of pure neroli oil: the chief places of their growth have hitherto been confined to the south of France and Piedmont. The French, favored by their climate, furnish half the world with this branch of their industry. The south of France is bounded by the Mediterranean, which I have before shown bears a striking resemblance in climate to Victoria, so that the whole of the above-mentioned plants and flowers might be grown here with equal advantage to Victoria as they have hitherto been to France.

Oil from flowers.—As I have before stated, the perfume of flowers is formed continually upon their surface, and flies off at the moment of its formation, and this is why such large quantities of flowers are required to obtain such a very small quantity of their oil or essence, which is retained by packing alternate layers of flowers and thin cotton fleece, or woollen cloth wadding, previously soaked in a pure and inodorous fat oil to catch the perfumes as they fly. It appears to me that a much larger quantity of oil might be obtained by covering the flowers while blooming or blowing with a similar preparation of cotton or woollen, by which means the perfume instead of "wasting its freshness on the desert air" (or at most for the benefit of a few workmen or visitors) might be retained by the unctuons covering, all volatile or essential oil having a peculiar affinity for unctuous fat or fixed oils, and when so retained could be distilled in the same manner as it now is from the unctuous cotton or woollen layers, which are submitted to distillation along with water when they give up their precious perfumes in the form of a volatile oil. "In order to extract the oils of certain flowers, as, for instance, of white lilies, infusion in a fat oil is sufficient."* On account of the great value of pure volatile oils from flowers they are generally mixed with alcohol, or "adulterated with fat oils, resins, or balsam of capivi,"* but the adulteration can generally be detected by simple tests.

"*Oil of lavender* is extracted from the flower spike of the

* Dr. Ure.

lavandula spica." The oil of spike of commerce is distilled from a wild variety of the same plant.

Oil of orange flowers or neroli is obtained as before stated. "Orange-flower water is obtained either by dissolving the oil in water, or by distilling with water the leaves, either fresh or salted, the first being the stronger, but the last being the more fragrant preparation."* Nice and Cannes together produce about 300,000 lbs. of orange blossoms annually.† I look forward to the time when the banks of the Murray below the Campaspe will teem with orange plantations, not alone on account of the perfume to be obtained from their blossoms but also on account of the valuable oil expressed from their leaves, and the rind of their fruit, or orange-peel, which contains a large quantity of oil, as any one can attest by simply squeezing a piece of orange-peel between their finger and thumb into the flame of a candle, when the oil from the peel will readily take fire. This oil is easily obtained by expression, and is used largely in scenting soaps and other perfumery. From the large quantity of essential oil obtained from orange-peel it might and probably would be found profitable to collect, by purchase or otherwise, the immense quantity now wasted in the colony; it could be expressed in the same way as linseed (which see).

Oil of bergamot, lemons, citron, &c., is obtained in the same way from the rind of the fruit.

"*Oil of bitter almonds* is prepared by exposing the bitter almond cake, from which the bland or unctuous oil has been expressed, in a sieve to the vapor of water or steam rising within the still, which carries off the volatile oil and condenses along with it in the worm of the still."* Perfumers employ a large quantity of this oil in scenting their soaps. The other essential oils likely to be manufactured here are the oil of juniper, which is obtained by distilling bruised juniper berries along with water; the oil of parsley, peppermint, rosemary, sassafras, thyme, acacia and jessamine blossoms, violets, hyacinths, and other tuberoses, &c.

PAPER.

In the year 1858 we imported paper, in the form of stationery and paper-hangings, to the value of about £200,000.‡ During the

* Dr. Ure.

† *Athenæum*.

‡ In 1859 we imported stationery to the value of £174,796, and paper-hangings to the value of £29,341.—C. MAYES, June 29, 1861.

same year we exported 516 tons of rags, which was probably not one half the quantity of rags that might annually be obtained here, because, in the first place, it is not generally known that rags are purchased in the colony, and, in the second place, the price given is so trifling as compared with their market value at home that few would care to save them for sale. As long as rags are purchased for exportation the price given will be very small; were paper-mills to be established here a larger price would be offered, and we should not then be in the habit of seeing cast off wearing apparel among our numerous rubbish heaps, or in the back yards and right-of-ways of our city and towns.

Up to the commencement of the present century paper was made entirely by hand, when the labor cost about 16s. per cwt.; the cost is now about 1s. per cwt. "This great change has been chiefly effected by Donkin, who has made for himself a place along with Watt, Wedgwood, and Arkwright, in the temple of mechanical fame."* Independent of the great superiority of machine over hand-made paper, manufacturers are not troubled with combination of workmen forming strikes, which was one of the serious drawbacks to the manufacturer of hand-made paper, another drawback being the large amount of waste, generally about 20 per cent., whereas by machinery it is a mere nothing. "Even so far back as 1843 there were 280 machines working in Great Britain, producing together 1600 miles of paper, from four to five feet broad, every day."* The great improvement in the patterns of china and earthenware is due chiefly to the manufacture of a superior description of tissue paper, "the hand-made paper being too coarse to trace the fair engravings required."* There is also an advantage when used for this purpose in the paper being of great length, and even in 1834 tissue paper was used in the potteries 1200 yards long; this length of paper, or in fact any great length, had never been made by hand labor. "In 1843 each machine was capable of making under the impulsion of any prime mover, unwatched by human eye, and unguided by human hands, from 20 to 50 feet in length by 5 feet broad of most equable paper in one minute."* Since then several patents have been taken out for improvements in paper-making machinery.

"The Chinese not only use rags in the manufacture of paper,

* Dr. Ure.

but also the fibres of the young bamboo, of the Chinese mulberry tree, the envelope of the silkworm cocoon, cotton down, and especially the cotton tree; they also make paper from their myrtle tree." *

In 1857 (Nov. 18th) a Mr. Alexander Tolmer obtained a patent in this colony for the manufacture of paper and pasteboard from the stems and leaves of the plant known as the *Lepidosperma gladiata*, and also from the root, stem, and leaves of the *Hybiscus* or marsh-mallow. This last plant grows luxuriously and spreads rapidly in deserted sheep stations, homesteads, and other places where it is not destroyed as a weed.

Paper Plant.—The Mineral Point *Tribune* has a description of a plant with the above name, discovered in Wisconsin by Miss A. L. Beaumont, who describes it as follows: "I discovered two years ago a plant that yields both cotton and flax from the same root, and I believe I am the first person that ever cultivated, spun, and knit from it. I am persuaded that any article that will make as good cloth as can be made from this plant will make good paper, hence I call it the 'paper plant.' It can be planted in the spring and cut in the winter. It bleaches itself white as it stands, and will yield at least three or four tons to the acre. From a single root that I transplanted last spring there grew 20 large stalks with 305 pods containing the cotton, with at least 60 seeds in each. From this root I obtained 7 ounces of pure cotton and over half-a-pound of flax. It is a very heavy plant, and grows from six to seven feet high. The editor of the *Tribune* who has seen samples of the cotton from this plant thinks that as an article for the manufacture of paper it must be far better and cheaper than any other known."—*Australian Builder*, Oct. 2nd, 1856.

As the proper cotton tree grows best within the tropics, and, therefore, not likely to be successfully cultivated in Victoria, it is interesting to know that the paper plant is indigenous to Wisconsin, which lies between 43° and 49° N. latitude, and assimilates more to the climate of Victoria than to that of the tropics. We may, therefore, reasonably expect to find but little difficulty in acclimatizing the paper plant in Victoria, to which it would be a most valuable acquisition.

* Dr. Ure.

Paper from Maize.—The *Illustrated London News* by August mail, 1860, contained an article on the “maize plant” which stated, among other important facts, that “The productiveness of this plant being so great, it is not to be wondered at that efforts have been made to cultivate it in Great Britain, and many years ago the late William Cobbett, of political celebrity, wrote a book on its virtues, recommending it to the British farmer. The *leaves and straw make good paper*, and Mr. Cobbett’s book was printed on paper made of this material.” It has been tried in England, but as was to have been expected, the average temperature of the seasons was not high enough to ensure the ripening of the grain. It is extensively cultivated in both N. and S. America from the tropics to 40° N. and S. latitude. It also produces good crops in Victoria, 7012 bushels being the produce of 750 acres during the year ending 31st March, 1860; this must either be a false return, or shows inferior cultivation, the average produce per acre being less than 10 bushels. From the Report on the Resources of the Colony I take the following:—“We are informed by A. McMillan, Esq., the discoverer of Gipps Land, that not less than 80 bushels of maize per acre for several successive years have been obtained on that gentleman’s estate on the Avon River, whilst the yield of wheat amounted to 35 bushels; oats, 50 bushels; barley, 45 bushels; and potatoes 6 tons to the acre.”

In addition to the paper plant, which may be grown here, and the leaves and stalks of maize which, with proper management, produces large crops, we have the flax plant, (a very fair crop of which was obtained in 1858, on the Experimental Farm, near Melbourne, and the fact that it will thrive well in this climate has, therefore, been fully established);* and several trees and plants indigenous to the colony, the bark of which might be converted into the coarser, if not the finer, kinds of paper. The cotton tree might also be grown on the north side of the River Murray, and the cotton transmitted to Melbourne by the Government railway now being made between Melbourne and the River Murray. The cotton tree could also be grown in the northern parts of South Australia and New South Wales; it has been already successfully cultivated in Queensland.

We have, therefore, abundant sources of material suitable for

* Report on the Experimental Farm.

the manufacture of all kinds of paper, and, as I have before shown, since 1843 it has been made in England with machinery so perfect as to require a very small amount of manual labor to produce miles or tons of paper. Even at the present rate of wages, with imported machinery propelled either by the Yan Yean water or the Yarra Falls, paper might yet be made in Melbourne as cheap as that imported.

Tracing Paper of the "best kind is made from the refuse of flax mills, and prepared by the engine without fermentation: it thus forms semi-transparent paste, and affords transparent paper."*

Paper Pipes.—An extract from an English paper appeared in the *Argus* of the 20th August, 1860, giving particulars of the "paper pipes" invented by a Mr. John Kennedy, which are likely to (a considerable extent at least) supersede the use of iron, lead, and clay pipes for "water, gas, or sewerage; they have been proved to stand a pressure of from 220 to 250 lbs. per square inch," which is more than sufficient for any practical purpose they can be applied to. "Then look at the price: a 3-inch pipe can be had at the rate of 1s. per yard, and other sizes in proportion;" a yard of 3-inch iron pipe $\frac{3}{8}$ of an inch thick would cost at least 3s. in England! "When they were referred to by Mr. Gladstone in his celebrated speech of the 10th February last, the idea of paper pipes was scouted; since then they have been largely patronised by the Government and many public bodies. In fact, the patentees for England cannot even meet the orders they receive." I have been given to understand on good authority that the patent has been extended to this colony, the patentees having an agent here, so that if they are not exchanged for our deleterious lead pipes now supplying water to the inhabitants of Melbourne and its suburbs, we may at least hope to see them used in our contemplated water and gas works throughout the colony.† It is not at

* Dr. Ure.

† Patent bituminised paper pipes are now made in Melbourne, samples of which have been tested by a Government Committee, from whose report dated April 29th, 1861, I learn that the pipes were "tried by hydraulic pressure, and 499 lbs. per square inch caused no leakage or breakage in a pipe $7\frac{1}{4}$ inches external and $6\frac{1}{4}$ inches internal diameter." The pipes are estimated to withstand a bursting pressure of 300 lb. per square inch; and the Committee feel that the excess named above that amount was ample as

all improbable that they will yet be made in the bush partly from the bark of our numerous forest trees.

PERFUMERY.

In 1858 we imported perfumery to the amount of £4237, exclusive of perfumed or scented spirits, which amounted to £13,021.* Under the head of "Oil" I have given particulars of the unctuous and essential oils, many of which are used in manufacturing pomatum or pomade, scented or perfumed oils and spirits, (and more especially "Eau de Cologne"), pastes, pastilles, &c.

Had we to import the principal ingredients required to manufacture perfumery, or perfumed spirits, it might not be worth particularising in this Essay; but when we consider that the whole of the ingredients are either produced or may be produced in this or the adjoining colony, and that we have no other use for the immense quantity of china or glassware in which they are imported, and which in many instances are as valuable as their contents, it seems probable that at no distant period we may not only manufacture for our own use, but also for exportation. As before stated, when treating of "Oils," "the South of France supplies at least half the world with perfumes" Some idea may be entertained of the magnitude of this branch of industry from an extract from the *Athenæum*, by which I learn that "Cannes and Nice produce 13,000 lbs. of violet blossoms annually. One great perfumery distillery at Cannes, uses yearly about 140,000 lbs. of orange blossoms; 20,000 lbs. of acacia blossoms; 140,000 lbs. of rose leaves; 32,000 lbs. of jessamine blossoms; 20,000 lbs. of violets, and 8000 lbs. of tuberose, together with a great many other sweet herbs."

Pomades or Pomatums, are made by mixing in a peculiar manner hog's lard, beef suet, and the leaves of the flowers whose perfume is required; these materials undergo certain preparations, simple and easily understood, but which I need not refer to more

evidence of the power of internal resistance. For further particulars, see Government report, to be obtained at the Dépôt, 127 Flinders lane east, Melbourne.—C. MAYES, July 1, 1861.

* In 1859, we imported perfumery to the value of £6812, and perfumed spirits to the value of £11,553.—C. MAYES, July 1, 1861.

particularly. As a substitute for flowers, which are too valuable except for the best pomades, "the essences commonly used in the manufacture of pomades, are those of bergamot, sweet lemon, rosemary, thyme, lemon thyme, lavender, marjoram, &c."*

Scented Oils are made by infusing flowers in pure fresh oil, such as rose leaves, orange flowers, &c.; the more delicate flowers, such as jessamine, jonquil, and violet, are spread upon stretched calico, saturated with salad or other suitable inodorous oil; fresh flowers are renewed until the oil is saturated with their odour, the calico is then pressed to obtain the scented oil, which operation requires seven or eight days.*

Essence of roses, orange flowers, violets, &c., are obtained by distillation, which is repeated for the best kinds.

Scented or perfumed spirits, of which so large a quantity are annually imported into this colony, are obtained by *digesting* 25 lbs. of the scented oil of roses, orange flowers, jessamine, or violets, &c., and 25 quarts of spirits of wine, for three days, when the perfumed spirits are drawn off.*

Eau de Cologne.—"The only essences which should be employed, and which have given such celebrity to this water, are bergamot, lemon, rosemary, Portugal, neroli, or the essence of orange flowers."*

Pastes are made from the kernels of apricots, almonds, &c.

Pastilles for burning are made with gum, nitre, cloves, charcoal powder, vanilla, &c.

Vanilla is the oblong narrow pod of the *epidendron vanilla*, Linn., which grows in Mexico, Columbia, Peru, &c. It has a delicious aroma, and is much sought after by makers of chocolate, ices, creams, by confectioners, perfumers, and distillers; * and is, therefore, a fruit well worth cultivating in Australia.

PISE,

I would call the attention of the public to the consideration and trial of pisé, as a substitute for brick and stonework, in the numerous, comfortable and cheap class of buildings required in this colony, such as *cottages, houses, homesteads, and country inns*, with their necessary *outbuildings and fences*; also *village churches, chapels, and schools*; and, in fact, to all purposes to which second-

* Dr. Ure.

rate brick or stonework can be applied. *Pisé* is a French word, and refers more to the method of moulding earths by compression into walls, &c., *in situ*, than to the material used.* At least twenty patents have been obtained in England during the last twenty years for artificial stones, or substitutes for brick and stonework; and although the majority of these inventions were deemed worthy of notice for a time, they were ultimately lost to the public, because they were found to be as costly or even more so than brick or stonework.

The common kind of *pisé* has been in use more or less since it was used by the Romans, in the time of Pliny, who speaks of buildings of compressed earth so durable as to be worthy of his especial notice. This kind of *pisé* has always been in use in most civilized countries, and has commended itself for its cheapness and durability. In Mexico, and some other parts of America, *pisé* houses are in general use. The city of the Mormons, on the Great Salt Lake, is built of *pisé*. In this colony little has hitherto been done, although I have seen at Yan Yean common *pisé* houses about twelve years old, and the conspicuous *pisé* tower known as Bear's Castle.

Concrete Pisé.—Concrete is a mixture of sand, gravel, and common lime, in proper proportions to form an artificial stone. In Great Britain, it is extensively used in foundations, particularly for bridges and other engineering works. It seems to have been little used in this colony; and I have seen valuable buildings cracked from top to bottom by unequal settlement, the foundations of which are saturated with water; this might have been prevented by the use of concrete. About the year 1837, Ranger's patent concrete made its appearance, in the walls of two important buildings in London, under Sir Charles Barry, the eminent architect. Mr. Ranger also built with his patent concrete several docks, wharves, the great sea wall of Brighton, (2000 yards long, and in parts 40 to 70 feet high), a church, a school (on the model of the Propylæa, at Athens), and several houses.† In 1851 I saw some concrete *pisé* houses at Norwood, near Adelaide, which, I believe, are still standing.

* For the method of constructing *pisé* walls, &c., see Weale's *Rudimentary Treatise on Cottage Buildings*, Cresy's *Cyclopædia of Civil Engineering*, &c.—C. MAYES, July 1, 1861.

† See *Civil Engineers and Architects' Journal*.

Beton Pisé.—Beton is the term given in France to a kind of concrete, made with hydraulic or water lime, and more generally used on the Continent than concrete is in England, for we find it applied not only to foundations and walls of houses, but also to a bridge, which, in 1840, was wholly built of *beton*, over the canal at Garonne: it was about forty feet span, and only five feet rise, and has stood some severe frosts without injury.

Although the application of concrete has been generally successful, it has failed in hydraulic works, such as the sea wall of Brighton, and the Woolwich and Chatham Docks; the reason of this is simply that proper hydraulic lime was not used in the face of the walls to protect them from the destructive effects of waves, tides, and frosts. It will be found in all such cases, where good strong hydraulic lime was used, the result has been satisfactory. Any one who has seen the *beton* walls of the Roman Tower of St. Alban's Abbey, and the massive concrete walls of Colchester Castle, will need no other conviction of the durability of this material, when applied to external walls. The greatest enemy to the preservation of *pisé*, *beton*, or concrete, is the action of the frost; and as they have been found to answer even in cold climates, I have good reason to suppose they will answer much better here, where it seldom freezes. *Pisé* has been brought to great perfection in most warm climates, and is in more general use on the Continent than in England.

The Victorian Industrial Society has from year to year offered premiums for the best method of manufacturing *pisé*, but I am not aware that their exhibitions have been attended with any marked success in this or any other branch of colonial industry, and the society has since died from the want of patronage.

In spite of the inferiority of either bark or slab huts, and the inefficiency of wooden houses to meliorate the sudden changes of temperature to which this colony is at all seasons so liable; and although neither bark, slab, or boarded houses, will keep out the intense heat of our Australian summers, so effectually as either stone, brick, or *pisé*, we still find such miserable substitutes for comfortable dwellings being erected throughout the bush, and slab huts with gapping chinks between every slab, occupying the place of equally cheap and really comfortable *pisé* walls, made of either loam, brick-earth, cobs or sods, concrete, *beton*, &c.

Under the head of cement and lime, I have shown how preva-

lent and universal is either limestone, cement-stone, or calcined earth; that the calcined earth would form a substitute for the real *puozzalano* of Italy, and that having limestone and cement-stone, combined with abundance of timber as fuel, we can readily manufacture lime or cement, and build concrete or *beton* walls without skilled labor.

POTASH.

Potash, or *Potassa*, so named because originally obtained from the *lixivium* of wood ashes evaporated in iron pots. "If lime is added to the solution of ashes, a corresponding portion of caustic potash will be introduced into the product with more or less lime, according to the care taken in decanting off the clear ley for evaporation."

"In America, where timber is in many places an incumbrance upon the soil, it is felled, piled up into heaps, and burnt, solely with a view to the manufacture of potash,"* which is also largely produced in Canada; in a similar manner "the farmer finds what is equivalent to a valuable crop; some extra trouble is, of course, necessary in the manufacture, but in many cases the product is sufficient to pay both for the land and the clearing."† Throughout Australia, although thousands of tons of timber are burnt annually, the ashes are never *lixivated* for the purpose of obtaining potash; not that we have no use for it, since it forms an essential constituent in the manufacture of soft soap, and we have had soap manufactories in Victoria for many years. It is also used in the manufacture of glass (see "*Glass*"), for which it will be required here, when the natural facilities we possess for the manufacture of glass are better known.

Water containing potash is softened by its presence, and this is the reason that the waters of the Yan Yean Reservoir are rendered so deleterious by contact with lead. The bush fires periodically occurring on its watershed deposit the wood ashes of the timber consumed, which is *lixivated* by subsequent rain-falls, and finds its way into the reservoir, or, before the reservoir was formed, on to its site, an immense swamp, which from time immemorial has been periodically impregnated with the *lixivium* of wood ashes or potash. When the immense embankment was about being con-

* Dr Ure.

† Canadian Correspondent.

structed across the entrance to the amphitheatre of hills forming the Yan Yean Reservoir, the timber upon its site was felled and burnt, not only into charcoal, which would have purified the water, but also into ashes, which has increased the presence of potash.

"All kinds of plants do not yield the same quantity of potash, although all plants yield more than trees. The more succulent the plant the more potash does it afford, since it is only in the juices that the vegetable salts reside, which are converted by burning into alkaline matter." "Canadian potash, as imported in casks, contains about 60 per cent., and the best pearlash 50 per cent. of absolute potassa." "The proportions of absolute potassa contained in 1000 parts of certain plants, are as follows, viz. :—Flax stems, 5; vine shoots, $5\frac{1}{2}$; barley straw, $5\frac{1}{2}$; fern, $6\frac{1}{2}$; large rush, $7\frac{1}{2}$; stalk of maize, $17\frac{1}{2}$; bean and sunflower stalks, each 20; thistles in full growth, $35\frac{1}{2}$; dry straw of wheat before earing, 47; wine lees, dried and pressed, 160." "Stalks of tobacco, potatoes, broom, heath, furze, sorrel, vine leaves, beet leaves, and many other plants abound in potash salts."

"*Pearlash* is prepared by calcining potash upon a reverberatory hearth till the whole carbonaceous matter and the greater part of the sulphur is dissipated, then lixiviating the mass, evaporating the clear ley to dryness in flat iron pans, and stirring it towards the end into white lumpy granulations"*

By mixing and otherwise manipulating lime with potash, caustic potash, or common caustic is produced. Carbonate, sulphate, nitrate, tartrate, &c., of potash, are obtained by certain chemical manipulations.

POTTERY.

Pottery is made from infusible earths which are refractory in the kiln, and continue opaque, such as earthenware, stoneware, flintware, delftware, ironstone, china, &c.

Improvements by J. Wedgwood.—"The greatest improvements in the manufacture of pottery and porcelain or china are due to Josiah Wedgwood. So sound were his principles, so judicious his plans of procedure, and so ably have they been prosecuted by his successors in Staffordshire, that a population of 60,000 operatives in

* Dr. Ure.

1843 derived a comfortable subsistence, within a district (formerly bleak and barren) of about 48 square miles in area, and which in 1843 contained 150 kilns, and was then, as it is now, significantly called the "Potteries."* Were an enterprising potter, with sufficient capital at his command, to endeavor to bring about such a change in Victoria as the enterprising indefatigable Wedgwood effected in England, his task would probably be far less arduous, since he would merely have to apply such materials as were at hand, and for every step and nearly every improvement he might find a precedent in the labors of Wedgwood, now so fully developed and understood. The truth of this statement will be made more apparent by the information I shall endeavor to convey in the course of this article.

Clays.—The pottery clays of England are in such demand that from 50,000 to 70,000 tons of blue clay are annually sent out of Dorsetshire, most of which finds its way to the Potteries in Staffordshire. This branch of industry alone finds employment for upwards of 7000 operatives merely in preparing the clay, which yields to St. Austell alone upwards of £240,000 every year.† Feldspar is also sent from Cornwall to the Potteries, and immense quantities of flints from the chalk formations of Yorkshire, &c., to the same place.

Victorian materials.—We possess all the materials required for the manufacture of earthenware and porcelain.

In the Report emanating from the Committee of the Royal Society of Victoria, I find it stated that "clays of a most excellent kind, suitable for bricks, and for the finest pottery, have been discovered at Phillipstown, Brunswick, and Hawthorn, and bricks are now made which are believed to be equal, in durability, to those of which the old Roman walls were constructed."‡

Mr. Selwyn, also, in his geological reports, refers to clays suitable for pottery of all kinds, occurring in many parts of the colony, exclusive of the fire-clays of our coal-fields.

Flints.—There are no flints in Australia; at least, none have yet been discovered, since we possess no chalk with which they are always associated. As a substitute for flints we have an abundance of pure milk-white quartz, which we are pulverising for the

* Dr. Ure.

† Home paper.

‡ See article in Appendix on "Bricks and Tiles."

sole view of extracting the gold it contains. This may at some future period be eagerly sought after, not only for pottery, but also for the manufacture of glass. Flints are ground in Europe expressly for mixing with kaolin or china clay for pottery ware, and the glaze with which they are coated.

Earthenware from Sludge—The very sludge of our gold-fields, on account of its present uselessness, has to be treated and disposed of at vast expense as an intolerable nuisance, may at some future period be sought after and used for earthenware. In the *Ballaarat Star*, in 1859, I found the following:—"We have seen some very nicely moulded and carefully burnt chimney pots made from sludge by a person near the cemetery. The specimen articles we inspected are beautifully smooth, of fine texture, and ring as soundly as a bell. Something will yet be made out of the 'sludge nuisance.'"

In England and other parts of the civilised world, clay is washed and made into bricks, tiles, and other earthenware, and even into highly valuable porcelain and china; but in Victoria we wash with an equal amount of trouble, and at least double the expense, equally valuable clay, and throw it away, or rather *in our way*, and then expend thousands of pounds sterling to get rid of the "sludge nuisance."

As mentioned under the article "Bricks," natural clays, or clay fit for bricks or earthenware, without being mixed with any other material, is rare in England. In the case of the "sludge nuisance," we find, near the sources of the sludge, that it consists mainly of silica or sand, which is heavier than pure clay or alumina, and, therefore, subsides sooner; but, if we follow down the sludge channel, we shall find that the proportion of sand to sludge, or liquid clay, is not so great, and at its *embouchure*, (unless the sludge has been agitated or stirred on purpose to cause it to hold the sand mechanically suspended, and thus carry it away) we shall find it to consist, for the most part, of finely pulverised washed clay, containing but little silica, or sand, and that little of the finest description. By simply washing, in a tumbler, and weighing samples of the clay or sludge in certain localities, we may ascertain the proportion the silica or sand bears to the alumina or clay, and mix it with other sludge or clay in such known proportions as are required for the article we intend manufacturing.

Victorian manufacture.—From the Blue-book for 1858, I find there were five potteries in the colony; two of these were at

Melbourne, one at Ballaarat, one at Sandhurst, one at Preston, and the other at Geelong.

Hitherto we have manufactured such articles as bricks, tiles, drain-pipes, chimney and flower pots, pans, and other stoneware, or common red earthenware. We have not hitherto made any delftware or crockery, porcelain or china, although I suspect the greater part of the £63,000 worth of earthenware imported here in 1858, consisted chiefly of delftware or crockery, in addition to £11,500 worth of tobacco-pipes for our smoking community. We also imported, and paid in the same year, £6086 for earthenware drain-pipes.*

At our Exhibition, in 1854, were to be seen, fire-bricks and flower-pots, made at the Toorak potteries; and also, flower-pots, water-coolers, spirit-jars, drain-pipes, made at North Melbourne, of common earthenware or stoneware. This seems hitherto to have been the height of our ambition in the manufacture of pottery, being the only kind that can generally be made with natural clay, without the intermixture of ground flints, or, as a substitute, ground quartz, which would require flint or quartz mills to grind it even finer than it generally comes from the quartz-crushing machines.

High Rate of Wages here.—Although we have abundance of suitable material in Victoria for all kinds of pottery, not excepting crockeryware or delft, and porcelain, on account of the present high price of labor, we cannot compete with the imported articles in Melbourne, although we may do so at Ballaarat, Sandhurst, and other places where the carriage and breakage would considerably enhance the present prices in Melbourne.

Evidence given before the Tariff Committee in 1860.—From the evidence given before the Tariff Committee, on the 2nd March last, I learn that although the pipe-clay of Batman's Swamp is of the best kind for pipes, jars, bottles, pans, &c., that the proprietor of the potteries there could not compete with similar imported articles. The rate of wages for potters were nearly double, and for laborers employed in the potteries, about four times the rate paid in England; and that, earthenware pipes, pans, &c., being packed one inside the other, came out as ballast,

* In 1859 we imported chinaware to the value of £4888; earthenware £47,869; drain-pipes (chiefly of stoneware) £7280; tobacco-pipes, £7322.

for £1 per ton, or even less; that the retail price of coals was as high as £3 per ton in Melbourne, and at the potteries (near the coal-fields) in England, only 10s. per ton. It was also stated in evidence, that notwithstanding these great differences in the price of labor and fuel, six-inch drain pipes, *e.g.*, could be made here for about 25 per cent. more than the cost of importing them, but that small articles, such as ginger-beer bottles, on account of the greater proportion of labor to material, cost nearly three times as much, even when made with the assistance of a machine. The proprietor of the Flemington potteries stated that he could make one mile of drain-pipes per week, in his establishment, and that there were thousands of acres of clay here as good as at home. Another potter stated that the fire-bricks made here would stand fire, but not the cooling afterwards, and that the real fire-clay, equal to the English, was found at Cape Patterson, and that with the proper fire-clay, good fire-bricks could be made here for less than we could import them. It is very evident that the greatest drawback to the economical manufacture of pottery, and many other articles, near Melbourne, is the high rate of labor, and the high price of coals; although, in the case of pottery, it by no means follows, that potters should use coals, particularly when suitable firewood can be obtained at about one-third the cost. In France, wood is the only fuel used for burning every description of pottery, not excepting the renowned Sevres porcelain or china.

Preparation of Clays for Pottery.—The clay is freed from stones when dug, and is then puddled and tempered, the same as for brick-making; it is then worked up into earthenware, stoneware, &c., but even for this purpose, as before stated, natural clay of a suitable quality cannot always be obtained, and most clays are generally mixed with certain proportions of silica or sand; but for delft and porcelain, ground flints are added in suitable proportions, according to the quantity or proportion of silica in the *natural clay*. The flints are burnt or roasted in kilns, ground in flint mills, and sifted to different degrees of fineness, according to the quality of ware required, in the same manner that quartz is roasted and crushed on the gold-fields; and which, as before stated, would answer all the purposes of pottery and porcelain. This flint powder, fine silica or quartz, is further reduced by flint mills into an impalpable powder; both the clay and flint powder are reduced to a standard degree of fluidity, mixed in certain proportions, and

intimately incorporated by pug mills. The mixture is next freed from excess of moisture, by evaporating in *sliphilns*, which resemble salt pans of saltworks, and, like them, have furnaces beneath them. When brought to a proper consistency, the dough is removed from the troughs or pans into damp cellars, where it is kept several months, by which it is mellowed, and is better than new *paste* for any kind of ware. The mass is once more incorporated by sluicing machines, and also by cutting lumps of the *paste* into, and slapping them together, when it is fit for the potter's wheel.

Throwing consists of shaping the dough previously weighed for certain articles by placing it upon the centre of the potter's wheel, which revolves rapidly while the potter gives it the required circular form by manipulating with his hands, assisted by wooden pegs and gauges for the size required; he then cuts it off the wheel with a fine brass wire, when it is gradually dried until it has attained a certain consistency, called the green state; it is then nicely turned to its proper shape in the turning-lathe, and slightly burnished with a smooth steel surface. The wheels and lathes in large establishments are worked by machinery. The handles, and other appendages are next attached to the vessel or article; they are then taken to the stove-room and heated to 80° or 90° Fahr., by which means they are fully dried. Such articles as cannot be fashioned in the lathe are pressed through apertures of the required size, the worm, or pipe-shape dough, as it issues is cut to the proper length and bent to the desired form.

Casting consists of pouring liquid clay into moulds of plaster of Paris which absorbs the moisture from the outside of the article, when the inside, which remains liquid, is poured out, leaving a shell of the thickness required. The castings, ornaments, &c., are joined together by slip, or liquid clay cement. Imitations of flowers and foliage are made by hand and joined in this way, which is called furnishing. The articles, being now ready for the kiln, are placed in fire-clay boxes, or saggars, which are piled up in the kiln into columns called bungs. *The fuel* used for firing the kilns in England is coal, which is supplied from time to time, test pieces, called ball-watches, being used to determine the temperature, and to guide the degree and duration of the firing, which lasts from forty to forty-two hours, when the kiln is gradually cooled and emptied,

the articles being dipped into a glaze; they are then fired in the glaze-kiln for about fourteen hours to fix the glaze.

Glazes consist of white lead, red lead, ground flints, flint glass, feldspar, soda, nitre, borax, chalk, oxide of tin, &c.

Metallic lustre for outside use consists of a glaze composed of sixty parts of litharge, thirty-six feldspar, and fifteen ground flints.

Gold lustre, platina lustre, iron lustre, marbling, &c., may also be produced and applied for ornamentation.*

PORCELAIN.

Porcelain consists of a fusible with an infusible earth, which, when combined, are susceptible of becoming semi-vitrified and translucent in the kiln.

The biscuit of the hard porcelain made at Sevres is generally composed of kaolin clay and decomposed feldspar; the kaolin is washed at the pit and sent to Sevres under the name of *decanted earth*.

Kaolin and feldspar are found in large quantities in the granite formations of Victoria.†

Fuel.—The fuel used at Sevres is aspin and white-wood for porcelain, the glaze being ground feldspar mixed with a little vinegar; every article is put into a sagger by itself, as they must not touch each other; the saggars are composed of similar materials to those used for glass-house pots.

The firing continues altogether from thirty to thirty-six hours, about twelve times as much fuel being used than is required for stoneware. With forty cubic metres of wood 12,000 stoneware plates may be completely fired, both in the biscuit and glaze kilns, while the same quantity of wood would bake at most only 1000 plates of porcelain.

Glass-house pots (*see glass*) are composed of a pure fire-clay (the constituents of which are equal portions of alumina and

* See article "Pottery," in Ure's Dictionary.

† The Victorian Government advertised for sale by tenders (in April, 1861) fifteen acres of kaolin or porcelain clay at Bulla Bulla, a post town eighteen miles from Melbourne, and from a letter headed "Resources of the Colony," which appeared in the *Argus* in February or March, 1861, I learn that works for the manufacture of porcelain, or chinaware, had been already established there.—C. MAYES, July 1, 1861.

silica, and in this respect resembles kaolin, which is disintegrated graphic granite, containing equal portions of feldspar and quartz), mixed with a fourth part of broken crucibles, or earthenware ground to powder.*

RUM.

The rum imported into Victoria in 1858 was valued at £70,519.†

Jamaica rum.—Rum is distilled from the fermented skimmings of the sugar-pans, or teaches, mixed with molasses and diluted with water to the proper degree. "The wort is made in Jamaica by adding to 1000 gallons of spent-wash, or dunder, 120 gallons of molasses, 720 gallons of *skimmings* (=120 molasses in sweetness) and 160 gallons of water, so that there may be in the liquid nearly 12 per cent. by weight of solid saccharum, or pure sugar."‡

Flavor of rum.—Spirits distilled from molasses do not contain the flavor of rum, the flavor of which is due to the large quantities of lees, or spent-wash, of former distillations. The fermentation goes on best in large masses, and requires from nine to fifteen days to complete the process. The quantity of rum produced is from four to five and a half gallons to each cwt. of sugar.

"*The wash* should be examined from day to day, and when it has reached its maximum strength, which can be ascertained by the hydrometer, it should at once be transferred to the still, and worked off by a proper-regulated heat (*see alcohol*); if it is allowed to stand over it will deteriorate by acetification."‡ The cane-juice, like the juice of grapes, will undergo spontaneous fermentation, but so slowly and irregularly that it is advantageous to quicken it by the addition of *dunder*; rum-distillers even soak woollen cloths in the yeast of fermenting vats to preserve the ferment from season to season. Sugar, if properly fermented, will yield its weight in proof spirit.

Sugar Refinery at Sandridge, near Melbourne.—A sugar refinery has been recently established at Sandridge in connection

* See Dr. Ure's Dictionary.

† In 1859 we imported rum to the value of £52,601.—C. MAYES, July 2, 1861.

‡ Dr. Ure.

with a distillery for the manufacture of rum, the only one of the kind in Victoria. There is a duty on all spirits distilled here from sugar of 9s. 3d. per gallon, and from grain 10s. per gallon.*

SALT.

Salt (culinary), or chloride of sodium, occurs in the form of rock salt in the saliferous or new red sandstone formation; the rock salt with the brine springs from it, affords the whole of the salt made in England. This formation is not known in Australia; we have therefore no rock salt here, but we have other sources of supply from our salt lakes and sea water. In 1858 we imported 5597 tons of salt, valued at £22,956, being about £4 per ton.†

Native salt is found on the shores of our salt lakes; it is very coarse (as all natural salt is) owing to the low temperature at which the salt water is evaporated. At Lake Hindmarsh it is found in vast quantities, and is very easy of access, as may be inferred from the fact that it is sold in the Ararat district at £3 per ton, being only a low charge for its cartage of about 100 miles on the Adelaide road. We have other salt lakes about 50 miles west of Geelong, the largest, Lake Korangamite, being about 100 square miles and Lake Colac about 20 square miles in area, besides many salt lagoons in this and other parts of Victoria, affording native salt already evaporated on their banks, the crystals being cubical, with their sides about $\frac{1}{8}$ of an inch in length.

Facilities for Manufacturing Salt.—With such vast quantities of native salt in several inland localities, all towns within say 50 miles of a salt lake might be supplied at a cheaper rate than from sea salt, obtained by the evaporation of sea water on our coasts. Salt from sea water is obtained by natural evaporation. The water is first retained in reservoirs constructed below the level of high water mark, in suitable localities, on the sea shore, the water being admitted by means of an inlet or open channel provided with sluice gates, by which it can be easily admitted and retained. In this reservoir its impurities may subside before it is allowed to flow

* In 1859 there were 4524½ gallons of rum distilled in Victoria.—C. MAYES, July 1, 1861.

† In 1859 we imported 8970 tons 18 cwt. of salt, valued at £42,606.—C. MAYES, July 1, 1861.

into brine-pits, which are divided by compartments, so as to be easily accessible for the purpose of raking the crude salt (left by evaporation) on to their sides.*

Brine-pits.—These brine-pits may be of any extent collectively, the object being to expose the largest amount of surface to the action of the sun and wind. Both the reservoir and brine-pits should be excavated in clay, or otherwise made impervious to water, or they would be likely to fill from fresh water land springs. Where clay forms the only lining, the salt derives its color from the color of the clay, and may be either brown, red, white, or grey, in which case it must be cleansed by boiling, and if quickly evaporated by proper salt-pans, will form fine table salt.* As this would probably be the description of salt generally required, there would be but little advantage in lining the reservoirs and brine-pits with either brick, paving tiles, or cement, which would add greatly to the cost of the excavation.

Purification of native salt.—Native salt is never found in a pure state, but contains from 1 to 7 per cent. of lime, magnesia, soda, oxide of iron, clay in a state of diffusion, &c. The chief of these impurities consists of magnesia, sea salt containing nearly nine parts in 1000, and twenty-five parts or $2\frac{1}{2}$ per cent. of pure salt; but sea water is easily purified and sweetened, by merely adding lime equal to the magnesia, or about 1 per cent. by weight of the water used, when it may be safely crystalised by rapid evaporation. The boilers constructed in Bavaria, at the salt-works of Rosenheim, consume 1 lb. of wood for every $3\frac{1}{2}$ lbs. of water evaporated, which is there considered a favorable result, but which might easily be increased to 5 lbs. by a better arrangement of the furnace and evaporating pans.* Should salt-works be established in Victoria, (with the view of dissolving and rapidly evaporating, for table salt, our vast depositories of lake salt) it would probably be advisable to establish such works as near as practicable to any lake in a thickly wooded district. According to M. Gay Lussac, 100 parts of water at 62° Fahr. (which is not greater than the average temperature of water in Victoria during the summer months) will dissolve thirty-five parts of salt. Supposing our lake salt to be dissolved with this proportion of water, one pennyworth of wood, at 5s. per ton (the price if

* Dr. Ure.

obtained on the spot), will evaporate 150lbs. of water (reckoning only 4 lbs. of water to 1lb. of wood); this would be equal to at least 50 lbs. of salt contained in 150lbs. of water. At 10s. per ton (the wholesale price of firewood delivered in Melbourne), it would only cost one penny for fuel to evaporate 25 lbs. of fine table salt.

European manufacture.—In France and Germany sea water is pumped into immense cisterns, built upon lofty towers, called graduation houses, from which it descends between skeleton walls, filled with bundles of thorns or fagots of brush-wood, the object being to bring the water in contact with the largest surface, for the purpose of speedy evaporation by the wind and sun. At Salza, near Schönebeck, there is a *graduation house* 5817 feet long, the thorn walls of which are from 33 to 52 feet high, and present a total surface of 25,000 square feet, but the water has to be raised and passed through the thorn walls about ten times to increase its specific gravity 0.013, so that sea water of the specific gravity of 1.030 would only be increased to 1.043 by this tedious process, allowing that during our summer months only five falls of the same water would produce this result, it is questionable whether the same result could not be obtained more economically by brine-pits. The saturated solution of salt before referred to would be about 1.196, and would therefore not require much boiling to raise it to a specific gravity of 1.200, when it is fit to be transferred to the evaporating or finishing salt pans, which are very shallow, and present nearly the whole of their underside to the furnace and flues.

In addition to lime, which is added to the brine, to convert the chloride of magnesia into an available deposit of chloride of lime, it is usual in the boiling to add a little bullock's blood, by which the sediment is thrown down in clarifying.*

Sea Water contains about $2\frac{1}{2}$ per cent, or one-fortieth of its weight of chloride of sodium or pure salt, so that it would cost one penny for firewood, at 10s. per ton, to evaporate 80lbs. of sea water, yielding at least 2 lbs. of pure salt; this would be equal to a halfpenny per lb., or about one-fourth of the value of the salt per lb. imported in 1858.

With the slight difference in height between high and low water, and the porous nature of the ground on the north coast of

* Dr. Ure.

Hobson's Bay, it might not be considered advisable to excavate reservoirs and brine pits near Melbourne to evaporate sea water for the purpose of obtaining salt, but there are many suitable localities for such works, where wind-pumps, or pumps worked by wind, might be brought into use to raise sea water into reservoirs, whose surfaces might be above the high water level of the adjoining beach.

SOAP.

In 1858 we imported 151 tons of soap, valued at £8161, or about £54 per ton; and during the same year we exported 174 tons, valued at £6000, being about £34 per ton.* The Blue-book for 1858 does not furnish any clue to explain this great difference in the value of imported and colonial soap. The only kind of soap (as far as I have been able to ascertain) hitherto made in the colony is the common brown bar soap. The whole of the soft soap used in Victoria is imported, and as it is about three times the price of common hard soap, the difference in the value of our imported and exported soaps may thus be partially accounted for.

The number of soap-boiling establishments in Victoria in 1858 was eighteen, three of which were in Melbourne, four in Prahran, and about the same number in Footscray. As we export more soap than we import, we may regard the successful manufacture of common hard soaps at least as a *fait accompli*. This description of soap is made by boiling together a decoction of soda, called soda ley, and tallow. In 1858 we imported 975 tons of alkali, chiefly soda, the greater portion of which was probably used in the manufacture of hard soap.

I am at a loss to account for the non-manufacture of soft soap in Victoria, since potash, the alkali used in the manufacture of soft soap, is imported for other purposes. Both potash and soda might be manufactured in Victoria from the raw materials, which are disseminated in abundance (see articles "Potash," and "Soda"). Whale or cod oil is used with tallow in making soft soap, which may therefore easily be manufactured in Victoria, since it affords

* In 1859, we imported 335½ tons of soap, valued at £13,036, and exported 305½ tons (121½ tons of which were the produce of the colony) valued at £10,601.—C. MAYES.

all the raw materials required. Toilet soaps are made from purified hogs' lard, olive, almond, hemp-seed, and other oils saponified with soda ley, and perfumed with bergamot and other scents.

SODA.

Crude carbonate, or the soda-ash of commerce is used in the manufacture of glass and soap. Although it may be obtained here, it is questionable whether it could be made as cheaply as it is imported, viz, at about 2d. per pound, owing to an essential ingredient in the manufacture, sulphuric acid, not being procurable from our raw materials in sufficient quantity for commercial purposes. Taking it for granted that we must import sulphuric acid at about 3d. per pound, and that about eleven ounces mixed with about fourteen ounces of common salt is required to make one pound of sulphate of soda, which has to be converted into crude soda or soda-ash, valued at 2d. per pound, it is evident it will not pay, unless the muriatic gas evolved and condensed into muriatic acid during the process of mixing the salt and acid be of sufficient value to make up the absolute loss in the production of soda, as shown by the above calculation. To convert sulphate of soda into soda-ash, the following process is necessary:—

Process of manufacture.—To 100 parts sulphate of soda add 110 parts of carbonate of lime or pure limestone, and fifty-five parts of coal-dust, or fifty parts of powdered charcoal; this mixture must be well ground and mixed together; it is then incinerated upon the hearth of a reverberatory or decomposing furnace, where the sulphur is driven off in from one to five hours, according to the quantity or charge: a charge of about 200 pounds of the last named mixture requiring not more than one hour and one man to complete the process: the product will consist of 168 parts of crude soda = 56 dry carbonate from the above mixture of 260 or 265 parts.

The extraction of pure carbonate of soda from soda-ash is accomplished by mixing it with its own weight of saw-dust, coal-dust, or powdered charcoal, and incinerating the mixture in a reverberatory furnace. It takes three or four hours to complete the process, the heat being just above the melting heat of lead.*

* Dr. Ure.

STARCH.

In 1858 we imported starch to the value of £14,000. Ordinary starch may be made from wheat, barley, oats, maize, potatoes, &c. The starch of commerce is made chiefly from wheat and potatoes.

Wheat Starch.—Wheat produces from thirty-five to forty per cent. of good starch, therefore, if it is grown here at 1½d. per pound, or about 7s. per bushel, the starch produced therefrom would cost 4d. per pound for material only, the present wholesale price of starch in Melbourne. The waste or refuse being at least one-half of the wheat, should pay all expenses of manufacture if used or sold as pigs' food. "Wheat partly damaged by storage may be used, as the starch is not affected by such injury."* It may be used either ground or not ground, but in either case it is steeped in water for from fourteen to twenty days, when it is put into bags and subjected to hydraulic pressure; the water containing the starch in solution on being pressed out of the wet wheat, is washed and allowed to deposit its starch in large cisterns; this deposit or pap is passed through fine sieves; when sufficiently dried and firm it is broken up and fully dried in drying rooms which are heated by stoves in winter. It may be colored blue by the addition of smalt if required. As colonial oats were sold as low as 3s. 6d., and imported at 2s. 9d. per bushel, in Melbourne, during the year 1860, it would be cheaper to use oats for this purpose, being only about two-thirds the price of wheat, or 1d. per pound. Oats afford about the same quantity of starch as wheat does, both by chemical analysis yielding at least seventy per cent. of starch, by which it would appear that there is plenty of room for improvement in the mode of manufacture.

Starch from Potatoes.—Red and sweet potatoes each contain fifteen per cent.; English potatoes, thirteen; and kidney potatoes, only nine per cent. of pure starch, according to the tabular statement of Dr. Ure. Although not grown to any extent in Victoria, Mr. E. Dacomb, of Portland, has grown both the red and white variety of sweet potatoes, many of them weighing nearly three pounds each. Such a prolific crop is well worth cultivating, if it were only for the manufacture of starch. So far back as 1843, machinery driven by two horses was able to rasp and perform all

* Dr. Ure.

other necessary operations in converting eighteen cwt. of potatoes into starch in one hour, including the pumping of the water required, the product in starch amounting to seventeen or eighteen per cent. of the potatoes. The quicker the process of making potato starch the better, on account of the great liability of potatoes to ferment when macerated.*

Potatoes can be grown here for about one halfpenny per pound; at this rate it would cost 3d. per pound for the materials of potato starch; the refuse, as with wheat starch, being equivalent in value as pigs' food for the cost of manufacture. Although potatoes may be grown at the above price, this will not include cartage. The starch mill may be used on the farm, the weight and consequently the carriage of the starch being only one-sixth the cost of the carriage of potatoes. It will thus be seen, that when the potatoes are grown at a great distance from a market, it may answer the purpose to convert them into starch, and thus save five-sixths of the cost of carriage.† In 1858 potatoes were imported here to the value of £107,540, although more than £12 per ton.

SUGAR.

In 1858 we imported raw sugar to the value of £543,000, and refined sugar to the value of £93,700, together upwards of £636,000; we have therefore ample scope for the growth of beetroot and its conversion into sugar, even to supply our own requirements in this respect.

Supposing we were to grow beetroot and manufacture sugar to this extent, we should only produce about one-eighth the quantity of sugar annually produced by France from beetroot. Dr. Ure states, that "the southern limit (in the northern hemisphere) is 45° of latitude for the successful cultivation of beetroot for the manufacture of sugar." From the report relating to the Experimental Farm I find that both sugar-beet and sorgho have yielded good crops, and are used in France and on the continent of Europe generally in the manufacture of sugar and spirits. Beet has not been grown to any extent in Victoria hitherto, only 8½

* Dr. Ure.

† From the *Argus* of the 26th April, 1861, I learn that a starch manufactory was about being established at Winter's Flat, near Castlemaine, which would be able to compete with imported starch.—C. MAYES, July 1, 1861.

acres having been cropped during the year ending 31st March, 1860, exclusive of that grown in market and kitchen gardens; but the fact, an important one, has been established, viz., that good crops have been and therefore may be again obtained here for the manufacture of sugar, if required for that purpose. In the manufacture of sugar from beet the root is grated by a grating machine, which obtains from 75 to 80 per cent. of juice; the amount of sugar obtained is only one-twentieth of the weight of the root, one ton of beet being required to produce one cwt. of sugar. The pulp obtained by the grating machine is put into bags and subjected to hydraulic pressure; the juice thus obtained is purified by adding one pound of lime to eighty gallons of expressed juice, which is filtered through blankets, concentrated by boiling, and again filtered, but this time through bone black or animal charcoal; it is next evaporated in swing pans over a brisk fire in quantities equivalent to half a cwt. of sugar, or four hectolitres of average juice.*

Sugar refining.—As before stated we imported refined sugar to the value of £93,760 in 1858. Without entering into the process of refining sugar, it will be I think sufficient to state that a sugar-refinery was established at Sydney some years ago and was found so remunerative that a similar refinery has been recently (1858) erected at Sandridge, in connection with a distillery, for the economical application of the molasses obtained from raw sugar, equal to about one-fifth of the sugar refined, which is taxed by the Government to the extent of 7s. per cwt.

Sugar cane.—The cultivation of the sugar-cane succeeds best at a mean temperature of about 76° , and may be successfully cultivated with an average temperature of not less than 67° , which is probably higher than the average temperature of the north-west boundary of Victoria, although not so much so as to warrant no trial being made on the banks of the Murray below the confluence of the Loddon river. The mean temperature of Melbourne is $59\frac{1}{2}^{\circ}$.

I have seen much information at various times upon the cultivation of the sorghum saccharatum for the manufacture of sugar, and am aware it is very much liked as green fodder by our cattle: as before stated it has, like sugar-beet, yielded good crops here. Maize has also been successfully grown in Victoria (*see Paper*);

* Dr. Ure.

like the other cereals it contains a considerable quantity of sugar in its stem, which may be extracted as from the sugar-cane.

TIN.

In 1858 we imported forty-seven tons of tin, besides tin-ware, tin-foil, and sheet-tin, valued together at £25,770; during the same year we exported 358 tons of black sand valued at £19,600, or about £54 per ton. There has not been so much as this exported since, probably on account of the operations of the Victoria tin smelting company who have established works in William-street, Melbourne, since March or February, 1860; my informant, who writes in the *Colonial Mining Journal* for March 1860, says, "We were agreeably surprised to find the works in operation, and the tin in ingots lying in quantities. The establishment of these works has been of great service to the Ovens miners, who now get the full value of the black sand. The company will be able to compete with the home market, and we believe a large trade with the neighboring colonies and India will follow."

Charcoal Sheet Iron and Tin Plate.—The best sheet-iron (which when tinned is called tin-plate) is made from charcoal iron (*see* Iron), which can be advantageously made from our hæmatitic iron ores and excellent charcoal, and now that we have tin-works might be profitably tinned here, large quantities of tin-plate or sheet-tin being used in Victoria for the manufacture of tin-ware. In 1858 we imported sheet-tin to the value of £11,762. From the evidence given by tinsmiths before the Tariff Committee on the 2nd March, 1860, I learn that "our tin smiths can compete with imported bulky articles on account of the high charge for freight, but not without the aid of machinery; that only the common and not the better class of articles are got up here; that tea-kettles and coffee-pots are made in England and Victoria too by females; and that a family of children make such articles in Richmond."

TOBACCO.

The duty, at 2s. per lb., upon tobacco imported in 1858 was £132,381, of which £108,327 was for American. During the year ending 31st March, 1860, there were 387 cwt. of tobacco

grown in Victoria, the average produce being about thirteen cwt. per acre, showing an increase of three cwt. per acre over the produce of 1853; but these average crops are capable of being extended to 20 cwt. per acre when properly cultivated with suitable seed. It is considered a profitable crop in New South Wales and should be so here, the latitude of Victoria being the same as Virginia, where it forms an important article of commerce. From the evidence given to the Tariff Committee in February and March 1860, by tobaccoists and growers of tobacco, I learn that the Australian is better for twist and as good for leaf tobacco as the American, but the generality of it is mixed with imported tobacco. The cost of manufacturing tobacco here is only sixpence per pound; the cost of producing the raw material may be estimated from the fact that two men can cultivate three acres, and could also pluck and prepare the leaf from June to February ready for manufacturing. Large quantities of tobacco of an inferior description is imported and used for sheepwash, which might be grown here for one-third or one-fourth less than the imported price.

The tobacco hitherto grown in Victoria has been inferior to that grown in New South Wales, where it pays the farmers to grow it at fourpence per pound, but here it costs eightpence. It is easily grown, children can pluck the shoots from the plants, or nip off the top of the stem, to throw all the strength into the leaves, as well or better than men. The best sample of tobacco hitherto grown in Victoria is that for which Mr. Christie, C.E., obtained the prize at the Horticultural show; it was grown from Havannah seed, and could be profitably manufactured into cigars; it is lighter in weight than the other kinds of tobacco, and is worth from one to two shillings per pound. All other tobacco hitherto grown in Victoria is believed to be from American seed, and as it is inferior to that produced by Mr. Christie, the cultivation of tobacco from Havannah seed is well worthy of our consideration. The witnesses examined by the Tariff Committee agreed that if the duty was reduced on raw or unmanufactured tobacco, that the manufacture of cigars in Victoria would give employment to several hundred men, women, and children, and that there were at present at least 200 cigar makers in the colony.

In 1858 we imported cigars to the value of £57,537, exclusive of the tobacco before referred to.

Our tobacco and cigar manufacturers have not been able to

compete with the imported article because our Victorian tobacco, hitherto, with a few exceptions, has not been of the quality required; but since Mr. Christie has proved the practicability of growing the best description of tobacco, it seems only necessary to grow similar tobacco from seed of a similar kind to produce tobacco here equal to any imported, and thus give employment to our cigar makers, besides numerous women and children. "Thousands are employed at home manufacturing tobacco from the imported leaf, because every man requires three or four boys to help him."

"A good cigar-maker can make 1000 best, and from 2000 to 3000 common cigars per week; 20lbs. of tobacco will make about 13lbs. of *regalia* cigars, the remaining 7lbs. is in the form of stalks and dust which, although generally sold at a reduced price for sheepwash, could be made into snuff."

VINEGAR.

Vinegar is produced by the fermentation of alcoholic drinks, and all alcoholic liquors are produced by the fermentation of saccharine matter or sugar.

Acetic Acid.—The essence or sour principle of vinegar is called acetic acid, and this may be made from any kind of alcoholic liquor, or from alcohol itself. In Germany, where it is cheap and plentiful, large quantities are converted into acetic acid; but as alcohol can be applied to so many other equally useful purposes in Victoria, it is not likely to be used for this purpose, since acetic acid may be made from brandy, rum, gin, or any other spirits; and should the manufacture of spirits be ever carried on in Victoria to any great extent, the bad spirits only are likely to be used for this purpose.

Vinegar.—The time required to convert any alcoholic liquor into vinegar depends simply upon the quantity of oxygen or common air that can be introduced into it; for this end it is best placed in shallow vessels, so that a large surface may be exposed. Acetification is most rapidly produced by a vessel called a *graduator*, which may be a cask standing on end and partially (about one-fourth) filled with the liquor required to be acetified, the whole of the cask being loosely filled with loose brushwood, string, or any light innocuous substance through which the air may

permeate and by which the liquor may rise and fall by capillary attraction; the cask or vessel is perforated with holes just above the liquor and also a little below the loose head or cover which is required merely to throw off the rain, if in the open air; by means of the ventilating holes currents of air are introduced throughout the vessel and acetification takes place, sometimes in two, but the general period required is about twenty days. The acetification in this instance, as in all vinegar manufactories, being merely the result of the second or acetous fermentation, may be promoted by the introduction of vinegar or the scum called *mother* which rises during the acetous, and acts in the same manner as yeast in promoting the first or vinous, fermentation in ale, &c.

The temperature required may vary between 60° and 90° ; if it is either below 60° or above 90° the acetification ceases. During the process of the acetous, the liquor rises in temperature as in the vinous fermentation, and a peculiar aromatic vapor is evolved; this continues until the whole of the alcohol is changed into acetic acid, when it falls to the temperature of the surrounding air.*

Having stated the principal facts to be borne in mind, with the mode of operation to be pursued in the manufacture of vinegar, it will be seen that this colony offers equal facilities with any other country, since the process is so simple as to be easily understood, and requires apparatus obtainable in any civilized country.

The particular kinds of vinegar likely to be made in this colony are—1, wine vinegar; 2, malt vinegar; 3, sugar vinegar.

1. *Wine Vinegar*.—As Victoria is likely to become a wine-producing colony, and as a large quantity of this wine may become sour, especially during the first few years, I will proceed to show how easily it may be turned to the best advantage by being completely acetified or converted into vinegar. I have already stated the general process, which is applicable to all kinds of vinegar-making. On account of a certain even temperature being required, it is necessary to prevent loss of time that this temperature should be preserved by a good fermenting room, capable of being warmed by flues in the winter. The rapid absorption of oxygen or vital air, especially when the *graduator* is used, renders it necessary that the fermenting room should be well

* Dr. Ure.

ventilated; and, if not warmed, that the ventilating holes should be closed in cold weather to keep up the temperature.

The room, if heated to about 105° Fahr., will produce a heat in the *graduator*s of about 77°, which is found to promote rapid acetification without injury to the vinegar. The upper part of the room is always the hottest, and the upper vats or vessels are most brisk in their operations. A supply of warm *wash* is kept near the ceiling, which may consist of either *mother* or good vinegar which is mixed with the alcoholic drink to be acidified; there are means of ascertaining when the acidification is complete.* Without entering into further details, my object is simply to show that the general principles of vinegar-making are simple and easily understood, and that our sour wine may be made the subject of an important manufacture.—[See *Wine*.]

2. *Malt Vinegar*.—Most of the British vinegar is made from malt wine or beer without hops; but that imported in the form of pickles, although called malt vinegar, is only wood vinegar or *Pyroligneous acid* (which see at the end of article on “Gas”). Although malt liquor is made expressly for vinegar, it must first become alcoholic or intoxicating before it can be acetified. These processes may be hurried by greater heat than would be deemed requisite, or even advisable, in the manufacture of ale or wine; yet I know of no system by which unfermented saccharine can be converted immediately into vinegar without being first changed into alcoholic fluids. By the ordinary methods three months are required to make good malt vinegar, but by using the *graduator* for the second fermentation this time may be much shortened. Wine vinegar differs from that made from corn, cider, sugar, &c., on account of the tartar extracted from the grape stones; but these may be introduced into the malt wine, or crude tartar may be added.*

3. *Sugar Vinegar*.—Vinegar may also be made from sugar, but as this is not a raw material raised in the colony, I shall merely add that vinegar may be made from any liquor containing alcohol, and that alcohol may be engendered in any liquor containing sugar or saccharine, and that saccharine can be produced in any grain containing starch by simply steeping and drying as with malt.

* Dr. Ure.

The quantity of vinegar imported into this colony in 1858 was about 75,000 gallons, valued at £9300. The nett profit in England by the annual produce of 100,000 gallons of malt vinegar, as stated by Dr. Ure, is £1409.

After writing the above I met with the "Evidence given to Select Committee on the Licensed Publicans Act," where W. Hull, Esq., J.P., states that the ale sent here from England, although good when shipped, is often damaged on the voyage, or even after being landed, before it leaves the merchant's hands: this ale will make splendid vinegar." * * "I believe that those *pricked* (sour) beers are used by the brewers here to get up their own making more quickly; they have not capital to hold." He proceeds to say—"Beer that is *pricked*, however much it may be doctored by the publican, nauseates the palate;" and, in the previous answer, "All the vinegar that I have used at my house for the last two years I have made myself from this beer."

WHISKEY.

Whiskey is the name given to ardent spirits produced from grain, potatoes, &c.

In 1858 we imported whiskey to the value of £40,466.* "Wheat produces from 40 to 45 per cent. of (its weight in) proof spirit; barley, 40 per cent.; rye, 36 to 42 per cent; oats, 36; and maize, 40 lbs. of spirit from 100 lbs., which is about the average produce of corn. Barley and rye are generally employed for making whiskey. It is deemed preferable to use a mixture of different grain, as wheat with barley and oats, or barley with rye and wheat. When barley is the only grain used, about 25 per cent. of malt is mixed with it; but when wheat and rye are added, about one-twelfth of barley malt is sufficient. Oats are well adapted for mixing with wheat, to keep the meal open in the mashing. The malt should be steam dried, except the smoky flavor called *peat-reek* is required, when it should be dried by a peat fire, or the whiskey itself may be impregnated with peat smoke, as is now often done. In 1843, when malt was 5s. per bushel in Scotland, the cost of whiskey distilled there was about 3s. per gallon."†

* In 1859 we imported whiskey to the value of £91,827.—C. MAYES, July 2, 1861.

† Dr. Ure.

Potato Whiskey is made from potatoes boiled with steam in a close vessel, and mashed into a homogeneous paste before they get cold. The paste is next triturated by a hand-machine, which triturates 1200 lbs per hour; which must be forthwith mashed with some ground wheat or barley, and a small proportion of malt, and then set to ferment. As potatoes readily pass into the acetous fermentation, the mixing, mashing, and cooling should be rapidly performed.

The fermentation is brisk, and furnishes a good head of barm, which answers well for the bakers; 100 lbs. of fresh dug potatoes yield about 16 lbs. or $1\frac{1}{2}$ gallon of proof spirits, but if they have sprouted they will yield very little spirit.*

WINE.

In 1858, we imported wine to the value of £269,432, £187,805 of which was direct from Great Britain, although not supposed to be manufactured there.†

From the great attention lately paid to the cultivation of the vine and manufacture of wine, there can be but little doubt entertained of Victoria becoming in a few years an important wine-producing colony. This result is almost inevitable from the high opinion generally entertained of the superiority of Australian wine already produced in this or the neighboring colony of New South Wales, and the high encomiums showered upon it by competent judges in both England and France. "At the Exhibition, in Paris, of wines from all parts of the world, it found few rivals, and was enthusiastically declared to be generous, peculiar (Australian), rich, and full of beauties which develop with age." (*Australian Almanac*, 1857).

Judging from the progress already made by Victoria in the manufacture of wine, she will soon equal, if not outstrip, New South Wales as a wine producing colony. During the year ending 31st March, 1860, we manufactured 13,954 gallons of wine, being an increase of 6214 gallons made in 1858. From the "Report of the Agricultural Association of the Ovens and Murray District" I learn that "Vineyards only 6 years old have yielded at

* Dr Ure.

† In 1859 we imported wine to the value of £342,613.—C. MAYES, July 2, 1861.

the rate of 500 gallons of wine to the acre, and vines of 3 years old have produced twelve pounds weight of grapes to each vine. An experienced vine grower compares our plants at the age of 3 years to those of 7 years' growth on the Rhine." From such encouraging reports we may reasonably expect great results.

The value of the wine annually produced in France is from £32,000,000 to £40,000,000, and upwards of 3,000,000 persons are employed in the production.

As Victoria is naturally a wine-producing country, it is not unlikely that we shall eventually produce an equal quantity as compared with the population of France. The manufacture of wine is beginning to be understood in Victoria through the ventilation given to the subject by our local journals, assisted by a pamphlet or two, published here. The details of wine making may vary throughout the world, but certain principles must always be attended to in order to insure success.

The grapes should be fully ripe, or rather over ripe, and also quite dry, when they are gathered.

A layer of grapes should then be thrown into a vat, or cistern of wood, and trod out, or otherwise macerated; the must, or juice, with the husks and stalks, are next put into the fermenting tun, or cask, where they will readily ferment without the addition of yeast or any other leaven, the rapidity of the fermentation depending upon the temperature of the air, which should not be too hot, or the must will be apt to acidify. The fermentation, in summer, will be active, or even violent, rising the liquor in the vat; this should continue until it loses much of its sweetness, when it should be drawn off into the ripening tun, the lees and *marc* of the grapes being pressed, and the liquor, which contains a considerable quantity of *tannin*, added to the wine. This liquor has the same effect upon the wine as hops on beer, viz., enables it to keep better and longer.

It is absolutely necessary that the ripening tun should be kept quite full, and in a cool place, otherwise there is considerable risk of the wine turning sour. The cask should also be allowed to overflow through the bung hole on the top, if it has a tendency that way, and should be filled up, from time to time, as long as the fermentation continues active; when it has apparently left off fermenting, a small bag of sand should be placed over the bung hole, to allow any further escape of the generated gas.

In about a month after the grapes were crushed, the sand bag should be replaced by a bung, surrounded with a piece of canvas, which should be driven tightly into the cask. The wine may now be considered made, and only requires to be kept cool (for a year at least) to ripen. If it cannot be kept in a well-closed underground cellar, it should be buried, since it cannot be safely kept in the wood during the summer, but must in this case be bottled off at the approach of spring, generally some time in August. The return of warm weather will induce a secondary fermentation, and the wine will sparkle, when drawn, in proportion to the amount of saccharine matter not hitherto converted into spirit of wine.

In making wine in considerable quantities, underground cellars for ripening the wine will be found indispensable.

WIRE.

Wire is produced by drawing metal rods through a steel plate pierced with tapered holes regularly graduated in size from the largest to the smallest gauge; this is fixed upon a draw-bench supporting the machinery, which is very simple and effective, and may be worked by either one or two men. "The metal requires to be annealed now and then between successive drawings, otherwise it would become too hard and brittle for further extension; it is also well supplied with wax for the smaller, and grease for the larger wires while drawing. Iron and brass wire of one-third of an inch in diameter can be drawn at the rate of from twelve to fifteen inches per second, but when one-fortieth of an inch in diameter, at the rate of from forty to forty-five inches in the same time. Wire by being diminished one-half, one-third, &c. in diameter, is increased in length four or nine times respectively."* Iron wire was imported here in 1858 to the value of £12,630.† When we take into account the high rate of freight for so bulky an article as wire, (generally imported in large circular coils) in conjunction with the fact that it is made by machinery, it seems probable we may compete with imported wire of all kinds.

* Dr. Ure.

† In 1859 we imported iron wire to the value of £20,676.—C. MAYES, June 29, 1861.

WOOLLENS.

In 1858 we imported woollens to the value of £226,663, and hosiery to the value of £71,259, to which may be added say half the wearing apparel and slops, equal to £230,000, making a total of about £528,000, exclusive of drapery, hats and caps, &c., which also include preparations of wool. Against this wholesale expenditure in imported woollen goods, we exported in the same year wool to the amount of £1,678,290, being 21,515,958 lbs., at about 18½d. per lb. Next to gold this is the chief article exported from the colony. It will be seen above that we import woollen goods to the value of upwards of half a million sterling; and as we have the raw material at hand in great abundance, it is really important that we should endeavor to manufacture some of those imported goods. An idea of the processes necessary to convert wool into woollens may be gleaned from the following:—

The wool is separated according to the quality required for different articles; the long wool is next separated from the short wool, the two kinds being used for different purposes requiring different treatment, the short wool being used for cloth, flannel, blanketing, &c., and the long wool for hosiery, *mousseline-de-laine*, and other open fabrics.

The long wool was formerly *combed* and straightened by men, but for the last thirty years it has been done by machinery, attended by children, by which means "the cheap and tractable labor of children is substituted for the high priced and often refractory workmen, too prone to capricious combinations." This remark of Dr. Ure is particularly applicable to our colonial manufactures, and shows the advantage of machine over hand labor.

All worsted and hosiery is made from the long wool, which is spun into a continuous thread and knitted by machinery, such as the plain and ribbed "*stocking frames*;" this is different to the weaving of cloth, which has two distinct threads crossing each other at right angles, and known as the *warp* and the *weft*.

Short wool for cloth is cleaned by machinery: it is passed through a machine called a *willy* several times and embued with oil; the wool is then *carded*, or straightened by machinery; the *slubbing* machine reduces the *cardings* into cord, sometimes called *rovings*, which is next spun into yarn or cloth by means of a *mule*

or *jenny*, which will also spin the finest *mousseline-de-laine* fabrics; the cloth is next *fulled*, by which means it is reduced to about half its breadth and two-thirds of its length, and is consequently very much thickened.

Teasling with thistles.—The next process is called *teasling*, which consists of raising the loose ends of the filaments and leaving the body of them entangled in the cloth. It is done by machinery, with the heads of thistles strung on a frame; the thistles were abandoned, not because any better substitute has ever been invented, but simply because the thistle heads became scarce in the neighborhood of cloth mills.* In the event of cloth mills being established here, even the "thistle nuisance" might be abated; nor is this the only use to which thistles can be applied: by referring to the article on "Potash," it will be seen that ripe thistles furnish the largest per-centage of potash excepting *wine lees*.

Cropping, or shearing off the filaments brought up by *teasling*, is also done by machinery, as well as the last operation, viz., imparting a lustre to cloth by passing it through hot water.*

Sydney Tweed.—It will be seen from the above imperfect description of the processes wool undergoes for conversion into woollen goods, that it is chiefly the work of machinery; and, as we might have expected, our enterprising neighbors of New South Wales have successfully competed with the importation of cloth by the manufacture of Sydney tweed. From the evidence given before the Tariff Committee, in February last, I learn that "Sydney tweed made in New South Wales is cheaper here than imported tweed of the same quality: it is made entirely of wool, and is therefore more durable than English tweed, which is more than half cotton." Sydney tweed was largely used in Victoria "before the gold-fields were discovered," which I imagine drained off the workpeople from the cloth mills, but now the *fever of gold-digging* has somewhat abated, it is again coming into more general use. In making tweed here we should save twelve months' loss of time and interest of money, also two or three merchants and brokers' profits, and the two freights, which has been found to equalise the cost of tweeds made in England and New South Wales. The gentleman who gave this evidence to the Tariff

* Dr. Ure.

Committee also stated "that he expected tweeds to be made here in two or three weeks." It is now eight months since, and I have heard nothing of any cloth mills being established in Victoria; such an event would be too important to be kept quiet.*

"CIVIL ENGINEER."

September 30th, 1860.

* On the 14th January, 1861, Messrs. Alexander Donaldson, E. Lush, and Colin Brown applied to the President of the Board of Land and Works for a grant or a long lease on moderate terms of eight acres of land contiguous to the waterfall in the Yarra, in Studley Park, where they contemplated investing at least £15,000 in establishing a factory for the manufacture of woollen cloth, by which means they would afford employment not only to the numerous weavers, but also to vagrant children, whose time was not only lost to the community, but who helped to swell our rapidly increasing juvenile criminal list. These enterprising gentlemen met with no encouragement from the head of the Lands Department, who considered it his duty to resist any further appropriation of the public reserves in the vicinity of Melbourne. (*See Argus*, 15th January, 1861.) It may be considered desirable to make an application for say one acre of the waste land on the south side of the Yarra falls, in Melbourne, or for a supply of the superabundant water from the Yan Yean, at a nominal rate; in the last case the projectors would have considerable latitude in their choice of a site, contiguous to the line of pipes.—C. MAYES, July 1, 1861.

APPENDIX.

ANTIMONY.

In the *McIvor News* about the 1st April, 1861, there is an account of a rich reef of antimony of great purity, discovered on a station at the Wappingtack, 8 miles from Heathcote. Several blocks of antimony weighing from 2 to 7 cwt. each, were obtained within a week after the discovery, and the account also states that the same line of reef has been opened up a mile nearer to the township, the indications of which are better than the first. This appears to be sulphuret of antimony, from which about 75 per cent. of the antimony of commerce may be obtained, the remainder being sulphur.—*See the Introduction to this Essay.*

Since the above announcement there have been several confirmatory statements of the continued richness of these antimony reef which are so extensive as to lead me to suppose that antimony will henceforth be among the list of our raw materials. It need not be shipped to be smelted, since it can be reduced by liquation, the method pursued at Malbosc, in the department of Ardèche in France; this process consists in sweating out by a regulated heat, from an alloy (in this instance of sulphur and antimony) an easily fusible metal from the interstices of a metal difficult of fusion. Lead and antimony are the metals most commonly subjected to liquation. The ore is placed in lined iron crucibles, which are charged every three hours, and when properly worked, 100 lbs. of antimony is obtained every hour. The above operation is remarkable for the small consumption of fuel, the economy of labor, and the complete exhaustion of the ore.*

Antimony forms part of the alloys of type metal, stereotype metal, music plate, and Britannia metal.

BRICKS AND TILES.

In 1859, we imported 125,000 building bricks, valued at from 36s. to £10 per 1000, the former from Memel and the latter from Hamburg. In the same year we also imported 136,624 firebricks, of these there were 37,000 from the United Kingdom, valued at £13, and 5000 from South Australia, valued at £14 per 1000. The high priced bricks were doubtless of the

* Dr. Ure.

first quality, since I also find 10,000 firebricks from Stettin (a port of the Baltic) among the list, valued at only £3 per 1000.

Hitherto we have not succeeded in making first class firebricks in Victoria, at least I have heard of none equal to the best English firebricks, most of those made here will stand any amount of heat, but will not stand cooling, an essential property in all such bricks. A sample firebrick was shown to me lately at the Collingwood Gasworks, made by Mr. Stirling, in Simpson's Road, East Collingwood, which in density, appearance and texture was more like a Staffordshire or Glasgow firebrick than any other I have hitherto seen.*

In the manufacture of ordinary colonial bricks we have a great need of economy. In consequence of the high price of labor in Victoria, machinery might be brought into use with greater advantage as compared with the cost of manual labor than in any other part of the world. *As a rule, one pounds worth of firewood in Victoria will raise steam equal to that raised by the same value of coal in England.*

Brick machines capable of tempering clay and turning out 1000 bricks per hour have been made in England and exported here, where they have been badly worked by horse-power to but little advantage. With a portable engine such machines might be made very efficient, and by a detailed estimate I find we might manufacture good bricks at 30s. per 1000, including 25 per cent. for wear and tear, interest on outlay and profit—were the machine to excavate the clay, the cost might be still further reduced.

Excellent bricks are made at Phillipstown, Brunswick, Northcote, and Hawthorn, all within 3 or 4 miles of Melbourne. They are heavier although not larger than the English bricks, and weigh from 3 tons and upwards per 1000; the carriage from either of the above places is therefore seldom less than 12s. per 1000 including loading, unloading, and stacking. In the case of Hawthorn this might be considerably reduced, on account of the inexhaustible supplies of superior brick earth to be obtained contiguous to the Melbourne and Suburban Railway, and its contemplated extension towards Kew. By means of short tramways the company's trucks could be loaded at the kiln, each truck containing two or three portable dray bodies to contain 400 bricks each, which could be lifted on to a suitable dray frame (with shafts, wheels, and axle complete) by means of a crane at the Melbourne terminus. By connecting the Melbourne and Suburban with the Hobson's Bay Railway, the bricks might be unloaded from the railway trucks at either Emerald Hill or Sandridge, at a slight additional cost for carriage by rail. Unless railways can be used in this way they are of no advantage for goods traffic except in long distances, because the extra cost of twice instead of once loading and unloading is greater than the

* Samples of these bricks may now be seen at the Exhibition, with certificates from the Engineer of the Melbourne Gas Works and Mr. Fulton, to the effect that they had put the bricks to the most severe tests, and found them equal to the best imported firebricks. With the bricks may also be seen samples of fire tiles, crucibles, &c., made at the same works.—C. MAYES, 4th November, 1861.

saving in the carriage by rail; the facility with which 25 or 30 cwt. is removed a few yards with a crane is well known

An enterprising firm or company who could deliver good bricks into Melbourne at about £2 per 1000 would doubtless soon command the whole of the market, and would also tend to give an impetus to building generally; that such a result could be easily achieved is capable of demonstration, and may occur to any one who understands the subject.

TILES.

The few tiles that have been imported into Victoria are probably included under the head of building materials, as tiles are not mentioned. The best substitute for tiles are slates, which were imported in 1859 to the value of £33,954.

Patent Tile Company.—On the 7th January, 1859, Mr. Joseph Curet obtained a patent in Victoria for improvements in the manufacture of tiles; this patent has been purchased by the above company, who have made tiles (similar to the Marseilles tile), a sample of which may be seen on the roof of the Building Museum, in Queen Street, Melbourne. I have seen and examined a sample of these tiles, and consider them in color, texture, and density equal to the English roofing tiles, but they are made with rolls and have too little lap for our low-pitched roofs, otherwise they seem to be much liked and are highly spoken of in testimonials (from Melbourne architects) at the foot of the prospectus I have now before me. The slight defect of inefficient lap will be easily remedied, and from the general preference shown for tiles instead of slates I have no doubt they would soon come into general use. Although much heavier and dearer than Countess slates in proportion to their size, yet from the manner they are used in roofing, a *square* of these tiles weighs less and costs less than a *square* of Countess slating.*

Paving Tiles have not hitherto been made in Victoria as a marketable article. The many uses to which this description of tiles are applied throughout Great Britain, and to which they might be applied in this colony renders it desirable that they should be manufactured here, where we possess equitable materials for this and other descriptions of common earthenware.*

Fire Tiles made with the same materials as firebricks are also much required in Victoria for ovens, cooking ranges, furnaces, &c. Vast quantities of fire tiles and a similar material made into large blocks, called *Welsh Lumps*, are sent from Wales into London and other parts of Great Britain, to be used in furnaces, fireplaces, &c.

BUTTER.

In 1859 we imported 3437 tons of butter, valued at £480,258, which is about 1s. 3d. per lb., showing an increase over the quantity imported in 1858

* Other descriptions of roofing tiles, also paving tiles, may now be seen in the Exhibition.—C. MATES, 4th November, 1861.

of 1318 tons, and a decrease in the value of about 1d. per lb. At the same time we find this enormous increase in the importation of butter, of about 38 per cent., we also ascertain from our Statistics for 1859 that there were no less than 2,656,880 acres of purchased land in Victoria uncultivated, 967,515 acres of which was not even enclosed, and at the same time we had only 358,728 acres under cultivation.

Australian Produce.—In 1859 we imported butter not only from the United Kingdom, but also from Denmark and Hamburgh; these being old established kingdoms we might reasonably have expected this as a result of the low rate of wages, but when we also find that the adjoining colonies of New South Wales, New Zealand, South Australia, and Tasmania, together exported butter in 1859 to the value of £75,072, we may reasonably enquire how it happens that these colonies, laboring under the same disadvantage of high priced labor, and under other similar circumstances, should be able to export butter while we pay nearly half a million annually for the importation of this very article which we might produce ourselves, since it has been sold lately at prices likely to compete with the price of imported butter; as might have been expected the demand for fresh butter has generally far exceeded the scanty supply.

The wholesale value of the butter imported in 1858 and 1859 was from 1s. 3d. to 1s. 4d. per lb; but in consequence of the absurd custom of the exporters of butter allowing only for about one-half the actual tare, the retail price, with only a reasonable profit, has often exceeded the price of our own fresh butter. How long this anomalous state of our colonial pastoral interests is to be tolerated, will depend greatly on the expected increase of emigration, and the facilities offered to men of small means to establish dairy farms throughout the colony.

Dairy homesteads should possess suitable dairies, buildings, or cellars, in which both the milk and butter can be kept at a proper temperature throughout the year. In the manufacture of butter, the proper temperature has been variously stated to be from 54 to 62 degrees, by Fahrenheit's (now the ordinary) thermometer.

Thermometer Churns.—Patent churns are imported here from America, called thermometer churns, to which a small thermometer is attached, but in such a position that it cannot be read after the process of churning is begun. The face of the glass tube is soon obscured by the application of hot water to the outer casing of the churn, combined with the process of churning. The secret or art of the rapid conversion of cream into butter rests mainly upon a certain temperature being observed, stated by the Patentee of these churns to be 62 degrees: this can be readily determined by a common thermometer applied to any churn.

Johnson's Patent Churn.—The butter of cream, and even new milk, is contained in small globules or sacs, which must be broken before they can be properly combined or agglutinated; this desideratum was rapidly achieved by Johnson's Patent American Churn, which was brought into use throughout the States about two years ago, where it has since been extensively patronised. In this churn the milk or cream is passed between rollers, which break the small bags of oleaginous matter forming the butter;

it is then manufactured or churned in a few minutes, if the proper temperature of about 62 degrees is observed throughout the operation. It thus appears that the object to be first accomplished in all churns, is to bring the milk or cream to the proper temperature, and then to break these little bags or globules; this has been generally done by concussion, but it is more effectually and sooner accomplished by the milk or cream being passed between rollers. It is not generally known that new milk may be churned without the trouble of setting and skimming it to obtain cream in the usual manner.

Temperature.—By referring to the original article on Butter, it will be seen, on the authority of Dr. Ure, that butter is soonest produced from cream when at a temperature of from 53 to 57 degrees Fahrenheit. I cannot explain the discrepancy between so high an authority and the Patentees of the Thermometer Churn; but as I know parties who have used this description of churn and have had no difficulty in producing butter at 62 degrees in a short time, I am disposed to think that the latter is the best temperature.

CEMENT.

In 1859 we imported cement to the value of £13,593, being £2387 in excess of the previous year, although the quantity was less in 1859 by seventy-three tons; its estimated value being about £6 13s. per ton in 1858, and about £8 8s. per ton in 1859; the average invoiced value of all cement imported in 1858 and 1859 being about £7 10s. 6d. per ton.

I have already shewn in the original article on this subject, that we possess an abundance of raw materials suitable for the manufacture of cement of many kinds; and after having studied the subject both theoretically and practically for many years, I am at a loss to know why cement manufactured in Victoria should not be equal to any that has hitherto been imported.

Mr. T. Edwards took out a patent in October last in Melbourne for the manufacture of lime and cement from materials brought to light in excavating the Reilly-street drain at the north end of Fitzroy and East Collingwood. It is a magnesian limestone or dolomite, and appears to be a deposit overlying the basalt or bluestone of that locality. Similar deposits (although not to so large an extent as to lead me to suppose they are of any great commercial value) may be seen on the surface of the cuttings on the Government railway between Melbourne and Sunbury, also at Guildford, on the Loddon, and on the Campaspe Plains, &c.

The Collingwood limestone has been analysed, and found to contain about 52 per cent. of carbonate of lime, 18 per cent. carbonate of magnesia, 12 per cent. alumina, and 18 per cent. of silica (hydrated), combined with sand, oxides of iron and manganese, alkaline salts, &c., the silica and sand varying from 9, to 22 per cent. There is a slight variation in the appearance and analyses of different samples, but the essential properties of good cement stone were found in both the samples analysed. Magnesian limestone, containing even 5 per cent. alumina, makes excellent hydraulic lime, and this

stone contains from 11 to 12 per cent. of alumina (the distinguishing characteristic of all cement stones as opposed to lime stones), it will therefore make a good, if not a superior hydraulic lime. If cement is required to set as quickly as the Roman and Portland cements, about one-eighth, or 12½ per cent. of pure clay should be intimately incorporated, by being ground up with this stone, and well mixed in a pug mill; the material must then be dried in small pieces, calcined, and again ground, and packed in casks for the market. If a market can be found here for a first-class hydraulic lime, this limestone, without any other ingredient, if properly managed, will supply such a market.

Vicat (the celebrated French engineer, and the first authority on limes and cements) in a recent article upon magnesian limestones (which seldom contain alumina) says, that "without clay (or alumina) limes cannot be decidedly hydraulic. * * * If, then, some portions of clay be present, it might happen that a triple hydrate of lime, of alumina, and of magnesia, might be formed, which should possess all the conditions of hardness and of progression (in hardness) which characterise the best hydraulic limes." He further states that two specimens of magnesian limestone, the one containing 4, and the other 5½ per cent. of clay, gave limes possessing the hydraulic character in an eminent degree. Parandier, another French engineer of note, states that "a magnesian limestone containing 11 per cent. of clay yields a very excellent hydraulic lime." The Collingwood limestone contains from 11 to 12 per cent. of clay.*

It is well known that cement made from stone containing too much silica, swells in setting, and is therefore likely to disturb the masonry executed with it. On the contrary, those cements in which alumina is in excess, are likely to shrink and to crack. "The magnesian limestones, or dolomites, appear to be the least exposed to these inconveniences, and to retain without alteration their original bulk."†

FUEL.

I have already treated upon the manufacture of charcoal in an article on that subject, I have also referred to coke and coking under the article "Gas."

Patent Hydrocarbonic Fuel.—"On the 26th November, 1857, Messrs. J. Chaplin and J. McRae, obtained a patent in Victoria for the manufacture of hydrocarbonic fuel, by combining two parts of charcoal with one part of coal, the charcoal to be first fully impregnated with hydrogen gas, the whole to be crushed and amalgamated by the application of heat and steam, and pressed into suitable sized blocks. The patentees state that this fuel leaves no clinkers and little or no smoke, and that one ton is equal to one

* Hydraulic lime may be seen in the Victorian Exhibition, made by mixing the alumina of fireclay and kaolin, or these articles in their crude state, with carbonate of lime in the form of pulverised limestone.—C. MATES, 4th November, 1861.

† *Limes, Cements, Mortar, &c.* By G. R. Burnell, C.E.

and a half tons of coal or three tons of wood, it will consequently occupy less space and is not liable to spontaneous combustion.*

Application.—It appears to me that this patent could be best carried out in conjunction with the manufacture of pyroligneous acid from our hardwoods, by which means the charcoal and hydrogen gas could be obtained from the wood, simultaneously with the crude wood vinegar. (See *Pyroligneous Acid*, under the article on "Gas.")*

Artificial Fuel.—"On the 30th September, 1858, Messrs. J. S. and T. Danks obtained a patent in Victoria for the manufacture of fuel from two or more or the whole of the following ingredients, viz., coals, coke, and charcoal in small pieces, or the dust of either, wood, wood sawdust, wood turnings, cuttings, shavings, and dried vegetable substances mixed intimately with pitch, resin, asphalt, wood or coal tar, naphtha, turpentine, or other inflammable spirits, suet or any fatty substance, the materials to be moulded or cut into any convenient form."

The last patent appears to monopolize the application of nearly every material of an inflammable nature, and as I have been accustomed to see many of these ingredients thrown away as rubbish, and allowed to rot on our wharves and rubbish depôts, I am at a loss to know why the patent has hitherto lain dormant.

Coal Tar.—According to Dr. Ure 100 lbs. of coal tar will produce 26 lbs. of coal oil, and 48 lbs. of pitch. As there is but little demand for coal tar in Victoria it might be found profitable to convert it into coal tar oil, either to be used as a substitute for kerosene and paraffine, or distilled as a substitute for naphtha, in which form it is extensively used for dissolving caoutchouc in making the varnish of waterproof cloth. The pitch may be used in many ways, one of these is in the manufacture of—

Grant's Patent Fuel, which is composed of coal dust and coal tar pitch, mixed together under the influence of heat in the proportion of 20 lbs. of pitch to 1 cwt. of coal dust, by appropriate machinery which grinds, sifts, heats to 220°, mixes, and moulds by pressure the fuel into lumps the size of common bricks, these are whitewashed, which prevents them sticking together even in hot climates. The advantages of this fuel over the common coals are many: It is said to produce 50 per cent more steam; to occupy less space; to be used with greater ease; to create little or no dust or dirt; also that the ignition is so complete as to produce but little smoke and ashes: and lastly, to be not liable to enter into spontaneous combustion. (See article *FUEL* in supplement to *Dr. Ure's Dictionary of Arts, &c.*)

CHAS. MAYES, C.E.

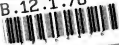
Hawthorn, July 15th, 1861.

* Pyroligneous acid, in its different processes of manufacture from our gum trees, may now be seen in the Victorian Exhibition.—C. MAYES, 4th November, 1861.

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